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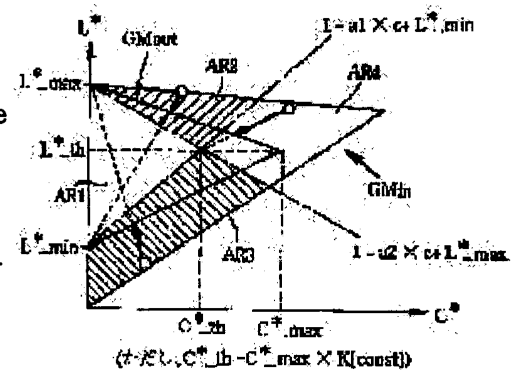
(54) COLOR AREA COMPRESSION METHOD AND DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To attain more natural color reproduction by taking the difference from color reproduction range of each device into account in a color DTP system.

SOLUTION: When a color reproduction range GMout of an output system is smaller than a color reproduction range GMin of an input system, a color reproduction area of the input system is divided into four on a 2-dimension plane consisting of a lightness L* and a saturation C* under the constant hue (h) by using two line segments, the compression direction is changed from areas AR1, AR2, AR3, AR4 to conduct color area compression and a color of color reproduction range GMin of the input system into a color of the output system color reproduction range GMout.



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CLAIMS

[Claim(s)]
[Claim 1] The color-gamut compression method characterized by quadrisecting the color-reproduction field of an input system into the fixed bottom for a hue using two straight lines on the two-dimensional flat surface of lightness and saturation, changing the compression direction for every field, performing color-gamut compression, and changing the color of the color-reproduction range of an input system into the color of the color-reproduction range of an output system when the color-reproduction range of an output system is smaller than the color-reproduction range of an input system.
[Claim 2] The color-gamut compression method according to claim 1 which carries out the feature of changing the above-mentioned 2 slopes of a line, and setting up the compression direction for every field by determining one parameter.
[Claim 3] About the color picture data of an CIE/L* C* h color space, it is Hue h The fixed bottom and lightness L* Saturation C* In a two-dimensional flat-surface top Saturation maximum C*_max of the color-reproduction range of an output system It crosses mutually the point on lightness value L*_th which it has (C*_th, L*_th), and is lightness L* of the color-reproduction range of the above-mentioned output system. Minimum value L*_min The 1st straight line along which it passes, Lightness L* of the color-reproduction range of the above-mentioned output system The color-reproduction field of an input system is quadrisected in the 2nd straight line which passes along maximum L*_max. It is supposed above the 1st straight line of the above that the color of the 1st field below the 2nd straight line remains as it is. The color of the 2nd field above the 1st straight line of the above and the 2nd straight line is compressed in the direction of a point (0 L*_min). It is the color-gamut compression method according to claim 1 characterized by compressing the color of the 3rd field below the 1st straight line of the above, and the 2nd straight line in the direction of a point (0 L*_max), and compressing the color of the 4th field above the 2nd straight line in the direction of a point (C*_th, L*_th) below the 1st straight line of the above.
[Claim 4] The color-gamut compression method according to claim 3 which carries out the feature of changing each inclination of the 1st straight line of the above, and the 2nd straight line, and setting up the compression direction for every field by being referred to as C*_th=C*_max xK and moving the point (C*_th, L*_th) describing above with the parameter K which becomes 0 <=K<=1.
[Claim 5] Value of the color picture data before color-gamut compression (L*_in, C*_in, h_in) It carries out. the value of the color picture data after color-gamut compression as (L*_out, C*_out, h_out) In the 2nd field of the above, they are two points (L*_min, 0, h_in) (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the input system on the straight line along which it passes, and an output system, respectively (L*_m, C*_m, h_in) It considers as (L*_p, C*_p, h_in). the value on a boundary with the 1st field as (L*_tmp, C*_tmp, h_in) L*_out=L*_tmp+ Compression to the direction of a point (L*_min, 0, h_in) made into (L*_p-L*_tmp)/(L*_m-L*_tmp) xL*_inC*_out=C*_tmp+(C*_p-C*_tmp)/(C*_m-C*_tmp) xC*_inh_out=h_in is performed. Moreover, in the 3rd field, they are two points (L*_max, 0, h_in) (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the input system on the straight line along which it passes, and an output system, respectively (L*_m, C*_m, h_in) It considers as (L*_p, C*_p, h_in) and is a value on a boundary with the 1st field (L*_tmp, C*_tmp, h_in). It carries out. L*_out=L*_tmp- Compression to the direction of a point (L*_max, 0, h_in) made into (L*_p-L*_tmp)/(L*_m-L*_tmp) xL*_inC*_out=C*_tmp+(C*_p-C*_tmp)/(C*_m-C*_tmp) xC*_inh_out=h_in is performed. Furthermore, in the 4th field, they are two points (L*_th, C*_th, h_in) (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the input system on the straight line along which it passes, and an output system, respectively (L*_m, C*_m, h_in) It carries out. (L*_p, C*_p, h_in) L*_out=L*_th+ Point made into (L*_p-L*_th)/(L*_m-L*_th) xL*_inC*_out=C*_th+(C*_p-C*_th)/(C*_m-C*_th) xC*_inh_out=h_in (L*_th, C*_th, h_in) The compression to a direction The color-gamut compression method according to claim 3 characterized by carrying out.

[Claim 6] Value of the color picture data before color-gamut compression (L*_in, C*_in, h_in) It carries out. the value of the color picture data after color-gamut compression as (L*_out, C*_out, h_out) In the 2nd field of the above, the field besides the color-reproduction range of an output system is received. Two points (L*_min, 0, h_in), The maximum of the color-reproduction range of the above-mentioned output system on the straight line which passes along (L*_in, C*_in, h_in) as (L*_p, C*_p, h_in) Compression to the direction of a point (L*_min, 0, h_in) made into L*_out=L*_pC*_out=C*_ph_out=h_in is performed. in the 3rd field of the above They are two points (L*_max, 0, h_in) to the field besides the color-reproduction range of an output system (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the above-mentioned output system on the straight line along which it passes as (L*_p, C*_p, h_in) Compression to the direction of a point (L*_max, 0, h_in) made into L*_out=L*_pC*_out=C*_ph_out=h_in is performed. further in the 4th field The maximum of the color-reproduction range of the above-mentioned output system on the straight line which passes along two points (L*_th, C*_th, h_in), and (L*_in, C*_in, h_in) to the field besides the color-reproduction range of an output system as (L*_p, C*_p, h_in) Point made into L*_out=L*_pC*_out=C*_pnh_out=h_in (L*_th, C*_th, h_in) The color-gamut compression method according to claim 3 characterized by performing compression to a direction.

[Claim 7] The color-gamut compression equipment characterized by providing the following. A field distinction means to distinguish to which field of each field which quadrisected the color-reproduction field of an input system in the fixed bottom using two straight lines on the two-dimensional flat surface of lightness and saturation a hue is belonged about input color picture data A color-gamut compression means distinguished with the above-mentioned field distinction means in the color-gamut compression which changes the color besides the color-reproduction range of an output system into the color of the color-reproduction range of this output system to change the compression direction and to perform it for every field

[Claim 8] The above-mentioned field distinction means is Hue h about the color picture data of an CIE/L* C* h color space The fixed bottom and lightness L* Saturation C* In a two-dimensional flat-surface top Saturation maximum C*_max of the color-reproduction range of an output system It crosses mutually the point on lightness value L*_th which it has (C*_th, L*_th), and is lightness L* of the color-reproduction range of the above-mentioned output system. Minimum value L*_min The 1st straight line along which it passes, Lightness L* of the color-reproduction range of the above-mentioned output system Maximum L*_max It distinguishes whether it belongs to the field of each field which quadrisected the color-reproduction field of an input system in the 2nd straight line along which it passes. the above-mentioned color-gamut compression means Based on the distinction result by the above-mentioned field distinction means, it is supposed above the 1st straight line of the above that the color of the 1st field below the 2nd straight line remains as it is. The color of the 2nd field above the 1st straight line of the above and the 2nd straight line is compressed in the direction of a point (0 L*_min). It is the color-gamut compression equipment according to claim 7 characterized by compressing the color of the 3rd field below the 1st straight line of the above, and the 2nd straight line in the direction of a point (0 L*_max), and compressing the color of the 4th field above the 2nd straight line in the direction of a point (C*_th, L*_th) below the 1st straight line of the above.

[Claim 9] The above-mentioned color-gamut compression means is the value (L*_in, C*_in, h_in) of the color picture data before color-gamut compression. It carries out. the value of the color picture data after color-gamut compression as (L*_out, C*_out, h_out) In the 2nd field of the above, they are two points (L*_min, 0, h_in) (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the input system on the straight line along which it passes, and an output system, respectively (L*_m, C*_m, h_in) It considers as (L*_p, C*_p, h_in). the value on a boundary with the 1st field as (L*_tmp, C*_tmp, h_in) L*_out=L*_tmp+ Compression to the direction of a point (L*_min, 0, h_in) made into (L*_p-L*_tmp)/(L*_m-L*_tmp) xL*_inC*_out=C*_tmp+(C*_p-C*_tmp)/(C*_m-C*_tmp) xC*_inh_out=h_in is performed. Moreover, in the 3rd field, they are two points (L*_max, 0, h_in) (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the input system on the straight line along which it passes, and an output system, respectively (L*_m, C*_m, h_in) It considers as (L*_p, C*_p, h_in) and is a value on a boundary with the 1st field (L*_tmp, C*_tmp, h_in). It carries out. L*_out=L*_tmp- Compression to the direction of a point (L*_max, 0, h_in) made into (L*_p-L*_tmp)/(L*_m-L*_tmp) xL*_inC*_out=C*_tmp+(C*_p-C*_tmp)/(C*_m-C*_tmp) xC*_inh_out=h_in is performed. Furthermore, in the 4th field, they are two points (L*_th, C*_th, h_in) (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the input system on the straight line along which it passes, and an output system, respectively (L*_m, C*_m, h_in) It carries out. (L*_p, C*_p, h_in) L*_out=L*_th+ Point made into (L*_p-L*_th)/(L*_m-L*_th) xL*_inC*_out=C*_th+(C*_p-C*_th)/(C*_m-C*_th) xC*_inh_out=h_in (L*_th, C*_th, h_in) The compression to a direction The color-gamut compression equipment according to claim 8 characterized by carrying out.

[Claim 10] The above-mentioned color-gamut compression means makes the value of the color picture data before color-gamut compression (L*_in, C*_in, h_in). the value of the color picture data after color-gamut compression as

(L*_out, C*_out, h_out) In the 2nd field of the above, the field besides the color-reproduction range of an output system is received. Two points (L*_min, 0, h_in), (L*_in, C*_in, h_in) The maximum of the color-reproduction range of the above-mentioned output system on the straight line along which it passes as (L*_p, C*_p, h_in) Compression to the direction of a point (L*_min, 0, h_in) made into L*_out=L*_pC*_out=C*_ph_out=h_in is performed. in the 3rd field of the above They are two points (L*_max, 0, h_in) to the field besides the color-reproduction range of an output system (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the above-mentioned output system on the straight line along which it passes as (L*_p, C*_p, h_in) Compression to the direction of a point (L*_max, 0, h_in) made into L*_out=L*_pC*_out=C*_ph_out=h_in is performed. further in the 4th field The maximum of the color-reproduction range of the above-mentioned output system on the straight line which passes along two points (L*_th, C*_th, h_in), and (L*_in, C*_in, h_in) to the field besides the color-reproduction range of an output system as (L*_p, C*_p, h_in) Point made into L*_out=L*_pC*_out=C*_pnh_out=h_in (L*_th, C*_th, h_in) Color-gamut compression equipment according to claim 8 characterized by performing compression to a direction.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] General picture input/output system (DTP:Desk Top Publishing), for example, desktop publishing centering on a workstation, It is related with the color-gamut compression method and color compression equipment which prepare in a system etc. and perform color-gamut compression processing of suitable color picture data.
[0002]
[Description of the Prior Art] Color gamut (Gamut) of the device which generally treats a color picture, i.e., the reappearance range of a color, Configurations differ for every device. Since a monitor performs a color reproduction by the additive color mixture by coloring of the fluorescent substance of red (R), green (G), and blue (B) in three primary colors, the color-reproduction range (Gamut) of a monitor is determined by the kind of fluorescent substance to be used. On the other hand, a printer is the color-reproduction range (Gamut) of a printer, although the color reproduction is performed by the cyanogen (C) of ink, MAZENDA (M), yellow (Y), and black (K). It changes with the kinds of paper and the reappearance form of gradation used as the record medium of not only the ink to be used but a picture.
[0003] For example, computer graphics (CG:Computer Graphic) They are the reappearance range of the color of a monitor, and the color-reproduction range of an ink jet printer a*-b* It is L* on a flat surface. As the result with which it integrated in the direction is shown in drawing 9 , it is the color-reproduction range GMijp of a printer. The color-reproduction range GMmon of a monitor It is small and especially the high saturation field of green (G) and blue (B) has very bad repeatability. Moreover, also in other hues out of which the difference has seldom come, the peak of saturation has shifted to above-mentioned drawing 9 in the direction of lightness. For this reason, when the color reproduction from a monitor to a printer is considered, especially the repeatability in high lightness and a high saturation field is not good.
[0004] Moreover, although there are many colors near an achromatic locus if the frequency in which a color with natural drawing high [saturation] appears is low and it is said [which] whether be, the color with the high saturation which cannot reproduce a monitor by the printer since it is drawn as an output is being used for CG picture in many cases. Therefore, since CG picture has many rates of the color besides the color-reproduction range even if it is going to output it by the printer, as compared with the time of printing natural drawing, its remarkable repeatability is bad.
[0005] Conventionally the device treating a color picture as image information Red (R), green (G), The camera and monitor which deal with blue (B) or brightness (Y), the color difference (U), (V) - (I), (Q), etc., Like the scanner which deals with cyanogen (C), MAZENDA (M), yellow (Y), black (K) or red (Dr), green (Dg), blue (Db), etc., and the printer, it suited under the environment used for a specific I/O device, connecting. Under such an operating environment, the color correction [KUROZUDO / only between I/O devices] is performed, and it is color-gamut compression (Gamut Compression). The color gamut (Gamut) of the I/O device, i.e., the reappearance range of a color, was also able to determine technique.
[0006] It will become impossible however, for many users to correspond by the color correction [KUROZUDO / between I/O devices] under the environment where various devices are connected, like a color DTP system.
[0007] Then, the concept of the color-reproduction technology (Device Independent Color) independent of the device that it will reappear in the same color also in various I/O devices is becoming as [require / concept]. Generally it is a color management system (CMS:Color Management System) about the thing of the system for realizing color-reproduction technology (Device IndependentColor) independent of this device. It is calling.
[0008] This CMS is realized by changing into the common color spaces (for example, CIE/XYZ, CIE/L* a* b*, etc.) which are not dependent on a device with the transformation or translation table called profile at once, when changing into the signal of an output system from the chrominance signal of an input system in connecting various I/O devices,

such as a camera 61, a scanner 62, a monitor 63, and a printer 64, as shown in drawing 10 .

[0009] In Above CMS, although it does not become a problem since it can output as it is when the color-reproduction range of an output system is larger than the color-reproduction range of an input system, when the color-reproduction range of an input system is larger than the color-reproduction range of an output system, depending on a picture, sexual desire news cannot be reproduced correctly as it is conversely. For example, since the color-reproduction range of a printer is smaller than a monitor when outputting the picture on a monitor to a printer, the color besides the reappearance range is unreproducible if it remains as it is. Therefore, in such a case, color correction processing which has a color besides the color-reproduction range in color-reproduction within the limits is needed, maintaining the original image information (gradation nature, tint, etc.) if possible. Thus, generally it is color-gamut compression (Gamut Compression) about stuffing an unreproducible color into color-reproduction within the limits by a certain processing physically. It is calling.

[0010] The lightness (lightness) which expresses the luminosity of a color to the consciousness to human being's color here, the saturation (chroma) showing the vividness of a color, and hue showing the system of a color (hue) There are three attributes. There is an CIE/L* C* h color space as a color space based on the three attributes of this human being's consciousness. L* Lightness and C* Saturation and h express the hue and can deal with these three attributes as an independent parameter.

[0011] The above-mentioned color-gamut compression (Gamut Compression) It is intelligible in consciousness to carry out in CIE / L* C* h color space, generally a hue (hue:h) is fixed and it is said to be good to carry out on the two-dimensional flat surface of lightness (lightness:L*) and saturation (chroma:C*).

[0012] Former and color-gamut compression (Gamut Compression) As technique, as shown in drawing 11 , it is lightness L*. It fixes and is saturation C*. It is [the saturation compressing method to compress and] saturation C* as shown in drawing 12 . It fixes and is lightness L*. It is L*-C* as shown in the lightness compressing method and drawing 13 which are compressed into a direction. The color difference minimum method which makes the color difference the minimum on a flat surface is learned.

[0013]

[Problem(s) to be Solved by the Invention] By the way, by the saturation compressing method learned conventionally, although the gradation nature of a high saturation field is maintained to some extent, it may become the picture which does not have a tint on the whole.

[0014] Moreover, although there is almost no fall of saturation by the lightness compressing method, a lightness difference will become extremely, so that saturation becomes high, since the high lightness field is compressed to low lightness and the low lightness field is compressed to high lightness, and all the fields that give and show a slash in drawing 12 will become the same color.

[0015] Furthermore, since the color difference becomes the minimum, although it becomes the mathematical original picture and a near picture by the color difference minimum method, in the field which gives and shows a slash in drawing 13 , all will become the same color.

[0016] Then, the purpose of this invention is to offer the color-gamut compression method and color-gamut compression equipment which could be made to do a more natural color reproduction in consideration of the difference in the color-reproduction range of each device in a color DTP system in view of the conventional actual condition like ****.

[0017]

[Means for Solving the Problem] When the color-reproduction range of an output system is smaller than the color-reproduction range of an input system, the color-gamut compression method concerning this invention The color-reproduction field of an input system is quadrisected into the fixed bottom for a hue using two straight lines on the two-dimensional flat surface of lightness and saturation. The color-gamut compression method which is characterized by changing the compression direction for every field, performing color-gamut compression, and changing the color of the color-reproduction range of an input system into the color of the color-reproduction range of an output system and which starts this invention again By determining one parameter, the above-mentioned 2 slopes of a line are changed, and the feature of setting up the compression direction for every field is carried out.

[0018] Moreover, with the color-gamut compression method concerning this invention, it is Hue h about the color picture data of an CIE/L* C* h color space, for example The fixed bottom and lightness L* Saturation C* In a two-dimensional flat-surface top Saturation maximum C*_max of the color-reproduction range of an output system It crosses mutually the point on lightness value L*_th which it has (C*_th, L*_th), and is minimum value L*_min of lightness L* of the color-reproduction range of the above-mentioned output system. The 1st straight line along which it passes, Lightness L* of the color-reproduction range of the above-mentioned output system Maximum L*_max The color-reproduction field of an input system is quadrisected in the 2nd straight line along which it passes. It is supposed

above the 1st straight line of the above that the color of the 1st field below the 2nd straight line remains as it is. The color of the 2nd field above the 1st straight line of the above and the 2nd straight line is compressed in the direction of a point (0 L*_min). The color of the 3rd field below the 1st straight line of the above and the 2nd straight line is compressed in the direction of a point (0 L*_max), and the color of the 4th field above the 2nd straight line is compressed in the direction of a point (C*_th, L*_th) below the 1st straight line of the above.
[0019] Moreover, by the color-gamut compression method concerning this invention, by being referred to as C*_th=C*_max xK and, for example, moving the point (C*_th, L*_th) describing above with the parameter K which becomes 0 <=K<=1, each inclination of the 1st straight line of the above and the 2nd straight line is changed, and the compression direction for every field is set up.
[0020] furthermore, by the color-gamut compression method concerning this invention For example, value of the color picture data before color-gamut compression (L*_in, C*_in, h_in) It carries out. the value of the color picture data after color-gamut compression as (L*_out, C*_out, h_out) In the 2nd field of the above, they are two points (L*_min, 0, h_in) (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the input system on the straight line along which it passes, and an output system, respectively (L*_m, C*_m, h_in) It considers as (L*_p, C*_p, h_in). the value on a boundary with the 1st field as (L*_tmp, C*_tmp, h_in) L*_out=L*_tmp+ Compression to the direction of a point (L*_min, 0, h_in) made into (L*_p-L*_tmp)/(L*_m-L*_tmp) xL*_inC*_out=C*_tmp+(C*_p-C*_tmp)/(C*_m-C*_tmp) xC*_inh_out=h_in is performed. Moreover, in the 3rd field, they are two points (L*_max, 0, h_in) (L*_in, C*_in, h_in). Maximum of the color-reproduction range of the input system on the straight line along which it passes, and an output system is made into (L*_p, C*_p, h_in), respectively (L*_m, C*_m, h_in). Value on a boundary with the 1st field (L*_tmp, C*_tmp, h_in) It carries out. L*_out=L*_tmp- Compression to the direction of a point (L*_max, 0, h_in) made into (L*_p-L*_tmp)/(L*_m-L*_tmp) xL*_inC*_out=C*_tmp+(C*_p-C*_tmp)/(C*_m-C*_tmp) xC*_inh_out=h_in is performed. Furthermore, in the 4th field, they are two points (L*_th, C*_th, h_in) (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the input system on the straight line along which it passes, and an output system, respectively (L*_m, C*_m, h_in) It carries out. (L*_p, C*_p, h_in) L*_out=L*_th+ Point made into (L*_p-L*_th)/(L*_m-L*_th) xL*_inC*_out=C*_th+(C*_p-C*_th)/(C*_m-C*_th) xC*_inh_out=h_in (L*_th, C*_th, h_in) The compression to a direction To . pan to perform, by the color-gamut compression method concerning this invention For example, value of the color picture data before color-gamut compression (L*_in, C*_in, h_in) It carries out. the value of the color picture data after color-gamut compression as (L*_out, C*_out, h_out) In the 2nd field of the above, the field besides the color-reproduction range of an output system is received. Two points (L*_min, 0, h_in), (L*_in, C*_in, h_in) The maximum of the color-reproduction range of the above-mentioned output system on the straight line along which it passes as (L*_p, C*_p, h_in) Compression to the direction of a point (L*_min, 0, h_in) made into L*_out=L*_pC*_out=C*_ph_out=h_in is performed. in the 3rd field of the above They are two points (L*_max, 0, h_in) to the field besides the color-reproduction range of an output system (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the above-mentioned output system on the straight line along which it passes as (L*_p, C*_p, h_in) Compression to the direction of a point (L*_max, 0, h_in) made into L*_out=L*_pC*_out=C*_ph_out=h_in is performed. further in the 4th field They are two points (L*_th, C*_th, h_in) to the field besides the color-reproduction range of an output system (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the above-mentioned output system on the straight line along which it passes as (L*_p, C*_p, h_in) Point made into L*_out=L*_pC*_out=C*_pnh_out=h_in (L*_th, C*_th, h_in) Compression to a direction is performed.
[0021] The color-gamut compression equipment concerning this invention a hue about input color picture data to the fixed bottom A field distinction means to distinguish to which field of each field which quadrisected the color-reproduction field of an input system using two straight lines on the two-dimensional flat surface of lightness and saturation it belongs, It is characterized by having a color-gamut compression means distinguished with the above-mentioned field distinction means in the color-gamut compression which changes the color besides the color-reproduction range of an output system into the color of the color-reproduction range of this output system to change the compression direction and to perform it for every field.
[0022] In the color-gamut compression equipment concerning this invention the above-mentioned field distinction means For example, it is Hue h about the color picture data of an CIE/L* C* h color space The fixed bottom and lightness L* Saturation C* In a two-dimensional flat-surface top Saturation maximum C*_max of the color-reproduction range of an output system It crosses mutually the point on lightness value L*_th which it has (C*_th, L*_th), and is lightness L* of the color-reproduction range of the above-mentioned output system. Minimum value L*_min The 1st straight line along which it passes, Lightness L* of the color-reproduction range of the above-mentioned output system Maximum L*_max It distinguishes whether it belongs to the field of each field which quadrisected the color-reproduction field of an input system in the 2nd straight line along which it passes. moreover,

the above-mentioned color-gamut compression means Based on the distinction result by the above-mentioned field distinction means, it is supposed above the 1st straight line of the above that the color of the 1st field below the 2nd straight line remains as it is. The color of the 2nd field above the 1st straight line of the above and the 2nd straight line is compressed in the direction of a point (0 L*_min). The color of the 3rd field below the 1st straight line of the above and the 2nd straight line is compressed in the direction of a point (0 L*_max), and the color of the 4th field above the 2nd straight line is compressed in the direction of a point (C*_th, L*_th) below the 1st straight line of the above.
[0023] In the color-gamut compression equipment concerning this invention moreover, the above-mentioned color-gamut compression means For example, value of the color picture data before color-gamut compression (L*_in, C*_in, h_in) It carries out. the value of the color picture data after color-gamut compression as (L*_out, C*_out, h_out) In the 2nd field of the above, they are two points (L*_min, 0, h_in) (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the input system on the straight line along which it passes, and an output system, respectively (L*_m, C*_m, h_in) It considers as (L*_p, C*_p, h_in). the value on a boundary with the 1st field as (L*_tmp, C*_tmp, h_in) L*_out=L*_tmp+ Compression to the direction of a point (L*_min, 0, h_in) made into (L*_p-L*_tmp)/(L*_m-L*_tmp) xL*_inC*_out=C*_tmp+(C*_p-C*_tmp)/(C*_m-C*_tmp) xC*_inh_out=h_in is performed. Moreover, in the 3rd field, they are two points (L*_max, 0, h_in) (L*_in, C*_in, h_in). Maximum of the color-reproduction range of the input system on the straight line along which it passes, and an output system is made into (L*_p, C*_p, h_in), respectively (L*_m, C*_m, h_in). Value on a boundary with the 1st field (L*_tmp, C*_tmp, h_in) It carries out. L*_out=L*_tmp- Compression to the direction of a point (L*_max, 0, h_in) made into (L*_p-L*_tmp)/(L*_m-L*_tmp) xL*_inC*_out=C*_tmp+(C*_p-C*_tmp)/(C*_m-C*_tmp) xC*_inh_out=h_in is performed. Furthermore, in the 4th field, they are two points (L*_th, C*_th, h_in) (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the input system on the straight line along which it passes, and an output system, respectively (L*_m, C*_m, h_in) It carries out. (L*_p, C*_p, h_in) L*_out=L*_th+ Point made into (L*_p-L*_th)/(L*_m-L*_th) xL*_inC*_out=C*_th+(C*_p-C*_th)/(C*_m-C*_th) xC*_inh_out=h_in (L*_th, C*_th, h_in) Compression to a direction is performed.
[0024] In the color-gamut compression equipment concerning this invention furthermore, the above-mentioned color-gamut compression means For example, value of the color picture data before color-gamut compression (L*_in, C*_in, h_in) It carries out. the value of the color picture data after color-gamut compression as (L*_out, C*_out, h_out) In the 2nd field of the above, the field besides the color-reproduction range of an output system is received. Two points (L*_min, 0, h_in), (L*_in, C*_in, h_in) The maximum of the color-reproduction range of the above-mentioned output system on the straight line along which it passes as (L*_p, C*_p, h_in) Compression to the direction of a point (L*_min, 0, h_in) made into L*_out=L*_pC*_out=C*_ph_out=h_in is performed. in the 3rd field of the above They are two points (L*_max, 0, h_in) to the field besides the color-reproduction range of an output system (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the above-mentioned output system on the straight line along which it passes as (L*_p, C*_p, h_in) Compression to the direction of a point (L*_max, 0, h_in) made into L*_out=L*_pC*_out=C*_ph_out=h_in is performed. further in the 4th field They are two points (L*_th, C*_th, h_in) to the field besides the color-reproduction range of an output system (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the above-mentioned output system on the straight line along which it passes as (L*_p, C*_p, h_in) Point made into L*_out=L*_pC*_out=C*_pnh_out=h_in (L*_th, C*_th, h_in) Compression to a direction is performed.
[0025]
[Embodiments of the Invention] Hereafter, it explains, referring to a drawing about the gestalt of operation of this invention.
[0026] this invention is carried out in the color management system (CMS:Color Management System) of composition as shown in drawing 1 .
[0027] CMS shown in this drawing 1 is the thing of fundamental composition of consisting of a device 5 of the device 1 of an input system, the color picture input section 2, the image-processing section 3, the color picture output section 4, and an output system. In the image-processing section 3 into which color picture data are inputted through the color picture input section 2 from the device 1 of an input system It is color-reproduction field compression processing (Gamut Compression) at a color space common to the above-mentioned color picture data. It gives and color picture data [finishing / this color-reproduction field compression processing] are outputted to the device 5 of an output system through the color picture output section 4 from the above-mentioned image-processing section 3.
[0028] The above-mentioned image-processing section 3 consists of the input-side transducer 31, the color-reproduction field compression processing section 32, and an output side transducer 33. The above-mentioned input-side transducer 31 changes into the color picture data of the common color space independent of the color gamut of the device 1 of the above-mentioned input system, for example, an CIE/L* C* h color space, the color picture data of the

color space of an input system depending on the color gamut of the device 1 of the color picture data, i.e., the above-mentioned input system, inputted through the color picture input section 2 from the device 1 of an input system. Moreover, the above-mentioned color-reproduction field compression processing section 32 performs color-reproduction field compression processing to the color picture data of the CIE/L* C* h color space supplied through the above-mentioned input-side transducer 31. And the above-mentioned output side transducer 33 is changed into the color picture data of the color space of the output system which depended on the color gamut of the device 5 of an output system for the color picture data of the above-mentioned CIE / L* C* h color space with which color-reproduction field compression processing was performed by the above-mentioned color-reproduction field compression processing section 32, and is outputted to the device 5 of the above-mentioned output system through the color picture output section 4.

[0029] Here, in the above-mentioned color-reproduction field compression processing section 32, color-reproduction field compression processing in which the procedure shown in the flow chart of drawing 2 was followed about the color picture data of CIE / L* C* h color space supplied through the above-mentioned input-side transducer 31 is performed.

[0030] That is, it is Hue h as the above-mentioned color-reproduction field compression processing section 32 shows the color picture data of an CIE/L* C* h color space to drawing 3 The fixed bottom and lightness L* Saturation C* The color-reproduction field GMin of an input system is quadrisected using two straight lines on a two-dimensional flat surface.

[0031] For the two above-mentioned straight line, one straight line is lightness L* of an output system. Minimum value L*_min It passes and the straight line of another side is lightness L* of an output system. Maximum L*_max It passes and crosses by one certain point. Here, the intersection of the two above-mentioned straight line is saturation maximum C*_max. It is on lightness value L*_th which it has.

[0032] The two above-mentioned straight line can be expressed with l=a1xc+L*_minl=a2xc+L*_max. The above a1 and a2 is the above-mentioned 2 slopes of a line, respectively, and is a1=(L*_th-L*_min)/C*tha2=(L*_th-L*_max)/C*th. Here, above-mentioned C*th is C*th=C*_maxxK. (however, K is a becoming constant 0 <=K<=1.) It is the parameter come out of and determined.

[0033] Therefore, the color-reproduction field GMin of the above-mentioned input system is quadrisected as follows.

[0034]

1st field AR1:a1xc+L*_min<=l<=a2xc+L*_max 2nd field AR2:l>=a1xc+L*_min, l>=a2xc+L*_max 3rd field AR3:l<=a1xc+L*_min and l<=a2xc+L*_max in the 4th field AR4:a2xc+L*_max<=l<=a1xc+L*_min above-mentioned color-reproduction field compression processing section 32 Value of the color picture data changed into the CIE/L* C* h color space (L*_in, C*_in, h_in) It carries out. the value of the color picture data after compression as (L*_out, C*_out, h_out) l=L*_in and c=C*_in are substituted for the formula of the two above-mentioned straight line, and a field is distinguished.

[0035] And if the above-mentioned color-reproduction field compression processing section 32 is the 1st field AR 1, it will carry out to a value as it is, i.e., L*_out=L*_inC*_out=C*_inh_out=h_in.

[0036] Moreover, if it is the 2nd field AR 2, it will compress in the direction of a point (L*_min, 0, h_in). this 2nd field AR 2 shows to drawing 4 -- as -- the color-reproduction range GMout of an output system from -- it considers as compressibility bigger as it separates For example, two points (L*_min, 0, h_in) (L*_in, C*_in, h_in), when the straight line along which it passes is considered, Maximum of the color-reproduction range of the input system on this straight line and an output system is made into (L*_p, C*_p, h_in), respectively (L*_m, C*_m, h_in). If the value on a boundary with the 1st field AR 1 is made into (L*_tmp, C*_tmp, h_in) It considers as L*_out=L*_tmp+(L*_p-L*_tmp)/(L*_m-L*_tmp) xL*_inC*_out=C*_tmp+(C*_p-C*_tmp)/(C*_m-C*_tmp) xC*_inh_out=h_in.

[0037] Moreover, if it is the 3rd field AR 3, it will compress in the direction of a point (L*_max, 0, h_in). this 3rd field AR 3 -- the color-reproduction range GMout of an output system from -- it considers as compressibility bigger as it separates For example, two points (L*_max, 0, h_in) (L*_in, C*_in, h_in), when the straight line along which it passes is considered, The maximum of the color-reproduction range of the input system on this straight line, and an output system, respectively (L*_m, C*_m, h_in) It considers as (L*_p, C*_p, h_in) and is a value on a boundary with the 1st field AR 1 (L*_tmp, C*_tmp, h_in). If it carries out It considers as L*_out=L*_tmp-(L*_p-L*_tmp)/(L*_m-L*_tmp) xL*_inC*_out=C*_tmp+(C*_p-C*_tmp)/(C*_m-C*_tmp) xC*_inh_out=h_in.

[0038] Furthermore, if it is the 4th field AR 4, it is a point (L*_th, C*_th, h_in). It compresses to a direction. this 4th field AR 4 -- the color-reproduction range GMout of an output system from -- it considers as compressibility bigger as it separates For example, two points (L*_th, C*_th, h_in) (L*_in, C*_in, h_in), when the straight line along which it passes is considered, If maximum of the color-reproduction range of the input system on this straight line and an output system is made into (L*_p, C*_p, h_in), respectively (L*_m, C*_m, h_in) It considers as L*_out=L*_th+(L*_p-

L*_th)/(L*_m-L*_th) xL*_inC*_out=C*_th+(C*_p-C*_th)/(C*_m-C*_th) xC*_inh_out=h_in.

[0039] It is compressible to save saturation if possible in the high lightness field AR 2, i.e., the 2nd field, and the low lightness field AR 3, i.e., the 3rd field, and to maintain gradation nature to some extent in the high saturation field AR 4, i.e., the 4th field, by such processing. Moreover, the discontinuity in the boundary by field division does not exist, either. Moreover, the fall of the method of saturation can be prevented by enlarging Parameter K to the minimum, by making K small, change of the direction of lightness can be made small and the gradation nature of a high saturation field can also be improved.

[0040] In addition, although the CIE/L* C* h color space was used as a color space independent of a device in the above-mentioned example, you may be made to perform color-gamut compression processing using other color spaces, such as a color space of Hunt, and a color space of Nayatani.

[0041] Moreover, at an above-mentioned example, it is the color-reproduction range GMout of an output system. It is the color-reproduction range GMout of the above-mentioned output system to all the colors of the 2nd containing the color to exceed, or 4th field AR2, AR3, and AR4. Although processing compressed inside was performed for example, it is shown in drawing 5 -- as -- the above 2nd or the 4th field AR2, AR3, and AR4 -- the color-reproduction range GMout of an output system exceeding -- a field -- AR -- two -- ' -- AR -- three -- ' -- AR -- four -- ' -- a color -- the nearest color within the color-reproduction range GMout of the above-mentioned output system -- compressing -- you may make .

[0042] That is, as shown in drawing 6 , the color of the 1st field AR 1 is made into a value as it is and L*_out=L*_inC*_out=C*_inh_out=h_in.

[0043] And in the direction of a point (L*_min, 0, h_in), by the 2nd field AR2', in the direction of a point (L*_min, 0, h_in), if it is the 3rd field AR 3, at the 2nd field AR2' To the direction of a point (L*_max, 0, h_in), it is a point (L*_th, C*_th, h_in) at the 4th field AR4' further. To a direction, it compresses, respectively and considers as L*_out=L*_pC*_out=C*_ph_out=h_in to it.

[0044] In this case, although the gradation which corresponds will become the same color, when the feeling experiment of ** compared CG picture with the conventional saturation compressing method, the lightness compressing method, and the color difference minimum method, the result which shows a predominance was obtained.

[0045] The feeling experiment of ** uses the 1st picture CG 1 including many yellow or much green, and two kinds of CG pictures of the 2nd picture CG 2 containing many blues or MAZENDA. The conventional saturation compressing method (A) as the technique of color-gamut compression, the lightness compressing method (B), and the color difference minimum method (C), [in the dark room which is not influenced of outdoor daylight about the case where a parameter is set to K= 0 (D), K= 0.75 (E), and K= 1 (F) by the technique shown in above-mentioned drawing 5] Install a monitor and a light box in the position of 90 degrees focusing on a subject, and the picture of two sheets from which the picture on a monitor and the technique of the color-gamut compression shown into a light box differ is compared. 33 subjects (19 men, 14 women) were made to judge which resembles the picture on a monitor among both about all combination (6x5 / 2= 15 kinds). As a picture shown into a light box, the output picture of two kinds of printers, a ** ink jet printer (A3+, 300DPI, KONTINIASU method) and a sublimated type printer (A4,163DPI), was used.

[0046] The result obtained by this feeling experiment of ** is shown in drawing 7 and drawing 8 . Each horizontal axis of drawing 7 and drawing 8 shows the difference in the technique of color-gamut compression, and the vertical axis expresses mental physical quantity, and it shows the result of resembling the picture on a monitor, so that a value becomes large.

[0047] That is, to CG1, technique (E) and (F) were good and the result [F / (F) / technique (A), (D), and] of being good was obtained by CG2.

[0048] In addition, the technique shown in above-mentioned drawing 5 brought a result with the sufficient case where a parameter is set to K= 0.75 (E) and K= 1 (F) in CG1. When referred to as K= 0 (D), there is some saturation omission and it is thought that it led to the fall of desirability. Moreover, in CG2, the result of resembling original was brought, so that the parameter was made small. Therefore, it is good to set up Parameter K within the limits of 0.5-1 by the technique shown in above-mentioned drawing 5 .

[0049]

[Effect of the Invention] By the color-gamut compression method concerning this invention, when the color-reproduction range of an output system is smaller than the color-reproduction range of an input system The color-reproduction field of an input system is quadrisected into the fixed bottom for a hue using two straight lines on the two-dimensional flat surface of lightness and saturation. Since the compression direction is changed for every field, color-gamut compression is performed and the color of the color-reproduction range of an input system is changed into the color of the color-reproduction range of an output system, color-gamut compression can be performed so that it may be more visible to nature.

[0050] Moreover, by the color-gamut compression method concerning this invention, since the above-mentioned 2 slopes of a line can be changed and the compression direction for every field can be set up by determining one parameter, when it applies to a color DTP system, where more natural color-reproduction nature is secured in consideration of the difference in the color-reproduction range of an I/O device, color-gamut compression can be performed.

[0051] Moreover, with the color-gamut compression method concerning this invention, it is Hue h about the color picture data of an CIE/L* C* h color space, for example The fixed bottom and lightness L* Saturation C* In a two-dimensional flat-surface top Saturation maximum C*_max of the color-reproduction range of an output system It crosses mutually the point on lightness value L*_th which it has (C*_th, L*_th), and is minimum value L*_min of lightness L* of the color-reproduction range of the above-mentioned output system. The 1st straight line along which it passes, Lightness L* of the color-reproduction range of the above-mentioned output system Maximum L*_max The color-reproduction field of an input system is quadrisected in the 2nd straight line along which it passes. It is supposed above the 1st straight line of the above that the color of the 1st field below the 2nd straight line remains as it is. The color of the 2nd field above the 1st straight line of the above and the 2nd straight line is compressed in the direction of a point (0 L*_min). Since the color of the 3rd field below the 1st straight line of the above and the 2nd straight line is compressed in the direction of a point (0 L*_max) and the color of the 4th field above the 2nd straight line is compressed in the direction of a point (C*_th, L*_th) below the 1st straight line of the above It can compress to save saturation if possible in a high lightness field, i.e., the 2nd field, and a low lightness field, i.e., the 3rd field, and to maintain gradation nature to some extent in a high saturation field, i.e., the 4th field, and is **.

[0052] By the color-gamut compression method concerning this invention, it is referred to as C*_th=C*_max xK, for example. 0 <=K<=1 moreover, with the becoming parameter K By moving the point (C*_th, L*_th) describing above, each inclination of the 1st straight line of the above and the 2nd straight line is changed. The compression direction for every field can be set up, the fall of the method of saturation can be prevented by enlarging Parameter K to the minimum, by making K small, change of the direction of lightness can be made small and the gradation nature of a high saturation field can also be improved.

[0053] furthermore, by the color-gamut compression method concerning this invention For example, value of the color picture data before color-gamut compression (L*_in, C*_in, h_in) It carries out. the value of the color picture data after color-gamut compression as (L*_out, C*_out, h_out) In the 2nd field of the above, they are two points (L*_min, 0, h_in) (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the input system on the straight line along which it passes, and an output system, respectively (L*_m, C*_m, h_in) It considers as (L*_p, C*_p, h_in). the value on a boundary with the 1st field as (L*_tmp, C*_tmp, h_in) L*_out=L*_tmp+ Compression to the direction of a point (L*_min, 0, h_in) made into (L*_p-L*_tmp)/(L*_m-L*_tmp) xL*_inC*_out=C*_tmp+(C*_p-C*_tmp)/(C*_m-C*_tmp) xC*_inh_out=h_in is performed. Moreover, in the 3rd field, they are two points (L*_max, 0, h_in) (L*_in, C*_in, h_in). Maximum of the color-reproduction range of the input system on the straight line along which it passes, and an output system is made into (L*_p, C*_p, h_in), respectively (L*_m, C*_m, h_in). Value on a boundary with the 1st field (L*_tmp, C*_tmp, h_in) It carries out. L*_out=L*_tmp- Compression to the direction of a point (L*_max, 0, h_in) made into (L*_p-L*_tmp)/(L*_m-L*_tmp) xL*_inC*_out=C*_tmp+(C*_p-C*_tmp)/(C*_m-C*_tmp) xC*_inh_out=h_in is performed. Furthermore, in the 4th field, they are two points (L*_th, C*_th, h_in) (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the input system on the straight line along which it passes, and an output system, respectively (L*_m, C*_m, h_in) It carries out. (L*_p, C*_p, h_in) L*_out=L*_th+ Point made into (L*_p-L*_th)/(L*_m-L*_th) xL*_inC*_out=C*_th+(C*_p-C*_th)/(C*_m-C*_th) xC*_inh_out=h_in (L*_th, C*_th, h_in) Since compression to a direction is performed It can compress to save saturation if possible in a high lightness field, i.e., the 2nd field, and a low lightness field, i.e., the 3rd field, and to maintain gradation nature to some extent in a high saturation field, i.e., the 4th field, and the discontinuity in the boundary by field division does not exist, either. Where it followed, for example, color-reproduction nature is secured for the above-mentioned CIE/L* C* h color space as a common color space in a color DTP system, color-gamut compression can be performed.

[0054] Furthermore, with the color-gamut compression method concerning this invention, it is the value (L*_in, C*_in, h_in) of the color picture data before color-gamut compression, for example. It carries out. The value of the color picture data after color-gamut compression as (L*_out, C*_out, h_out) in the 2nd field of the above They are two points (L*_min, 0, h_in) to the field besides the color-reproduction range of an output system (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the above-mentioned output system on the straight line along which it passes as (L*_p, C*_p, h_in) Compression to the direction of a point (L*_min, 0, h_in) made into L*_out=L*_pC*_out=C*_ph_out=h_in is performed. in the 3rd field of the above They are two points (L*_max, 0, h_in) to the field besides the color-reproduction range of an output system (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the above-mentioned output system on the straight line along which it passes as (L*_p,

C*_p, h_in) Compression to the direction of a point (L*_max, 0, h_in) made into L*_out=L*_pC*_out=C*_ph_out=h_in is performed. further in the 4th field They are two points (L*_th, C*_th, h_in) to the field besides the color-reproduction range of an output system (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the above-mentioned output system on the straight line along which it passes as (L*_p, C*_p, h_in) Point made into L*_out=L*_pC*_out=C*_pnh_out=h_in (L*_th, C*_th, h_in) Since compression to a direction is performed It can compress to save saturation if possible in a high lightness field, i.e., the 2nd field, and a low lightness field, i.e., the 3rd field, and to maintain gradation nature to some extent in a high saturation field, i.e., the 4th field, and the discontinuity in the boundary by field division does not exist, either. Where it followed, for example, color-reproduction nature is secured for the above-mentioned CIE/L* C* h color space as a common color space in a color DTP system, color-gamut compression can be performed.

[0055] In the color-gamut compression equipment concerning this invention, a hue about input color picture data to the fixed bottom A field distinction means to distinguish to which field of each field which quadrisected the color-reproduction field of an input system using two straight lines on the two-dimensional flat surface of lightness and saturation it belongs, Since it has a color-gamut compression means distinguished with the above-mentioned field distinction means in the color-gamut compression which changes the color besides the color-reproduction range of an output system into the color of the color-reproduction range of this output system to change the compression direction and to perform it for every field When the color-reproduction range of an output system is smaller than the color-reproduction range of an input system, color-gamut compression which changes the color of the color-reproduction range of an input system into the color of the color-reproduction range of an output system so that it may be more visible to nature can be performed.

[0056] Moreover, with the color-gamut compression equipment concerning this invention, it is Hue h by the above-mentioned field distinction means about the color picture data of for example, an CIE/L* C* h color space The fixed bottom and lightness L* Saturation C* In a two-dimensional flat-surface top Saturation maximum C*_max of the color-reproduction range of an output system It crosses mutually the point on lightness value L*_th which it has (C*_th, L*_th), and is lightness L* of the color-reproduction range of the above-mentioned output system. Minimum value L*_min The 1st straight line along which it passes, Lightness L* of the color-reproduction range of the above-mentioned output system Maximum L*_max It distinguishes whether it belongs to the field of each field which quadrisected the color-reproduction field of an input system in the 2nd straight line along which it passes. moreover, the above-mentioned color-gamut compression means Based on the distinction result by the above-mentioned field distinction means, it is supposed above the 1st straight line of the above that the color of the 1st field below the 2nd straight line remains as it is. The color of the 2nd field above the 1st straight line of the above and the 2nd straight line is compressed in the direction of a point (0 L*_min). Since the color of the 3rd field below the 1st straight line of the above and the 2nd straight line is compressed in the direction of a point (0 L*_max) and the color of the 4th field above the 2nd straight line is compressed in the direction of a point (C*_th, L*_th) below the 1st straight line of the above It is compressible to save saturation if possible in a high lightness field, i.e., the 2nd field, and a low lightness field, i.e., the 3rd field, and to maintain gradation nature to some extent in a high saturation field, i.e., the 4th field.

[0057] In the color-gamut compression equipment concerning this invention, moreover, by the above-mentioned color-gamut compression means For example, value of the color picture data before color-gamut compression (L*_in, C*_in, h_in) It carries out. the value of the color picture data after color-gamut compression as (L*_out, C*_out, h_out) In the 2nd field of the above, they are two points (L*_min, 0, h_in) (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the input system on the straight line along which it passes, and an output system, respectively (L*_m, C*_m, h_in) It considers as (L*_p, C*_p, h_in). the value on a boundary with the 1st field as (L*_tmp, C*_tmp, h_in) L*_out=L*_tmp+ Compression to the direction of a point (L*_min, 0, h_in) made into (L*_p-L*_tmp)/(L*_m-L*_tmp) xL*_inC*_out=C*_tmp+(C*_p-C*_tmp)/(C*_m-C*_tmp) xC*_inh_out=h_in is performed. Moreover, in the 3rd field, they are two points (L*_max, 0, h_in) (L*_in, C*_in, h_in). Maximum of the color-reproduction range of the input system on the straight line along which it passes, and an output system is made into (L*_p, C*_p, h_in), respectively (L*_m, C*_m, h_in). Value on a boundary with the 1st field (L*_tmp, C*_tmp, h_in) It carries out. L*_out=L*_tmp- Compression to the direction of a point (L*_max, 0, h_in) made into (L*_p-L*_tmp)/(L*_m-L*_tmp) xL*_inC*_out=C*_tmp+(C*_p-C*_tmp)/(C*_m-C*_tmp) xC*_inh_out=h_in is performed. Furthermore, in the 4th field, they are two points (L*_th, C*_th, h_in) (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the input system on the straight line along which it passes, and an output system, respectively (L*_m, C*_m, h_in) It carries out. (L*_p, C*_p, h_in) L*_out=L*_th+ Point made into (L*_p-L*_th)/(L*_m-L*_th) xL*_inC*_out=C*_th+(C*_p-C*_th)/(C*_m-C*_th) xC*_inh_out=h_in (L*_th, C*_th, h_in) Since compression to a direction is performed It can compress to save saturation if possible in a high lightness field, i.e., the 2nd field, and a low lightness field, i.e., the 3rd field, and to maintain gradation nature to some extent in a high

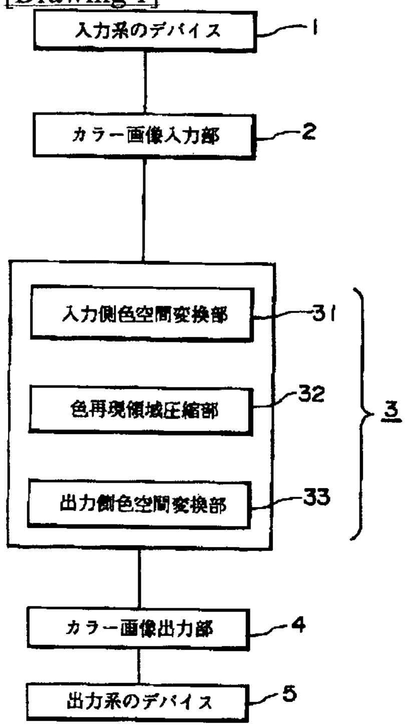
saturation field, i.e., the 4th field, and the discontinuity in the boundary by field division does not exist, either. Where it followed, for example, color-reproduction nature is secured for the above-mentioned CIE/L* C* h color space as a common color space in a color DTP system, color-gamut compression can be performed.

[0058] In the color-gamut compression equipment concerning this invention, furthermore, by the above-mentioned color-gamut compression means For example, value of the color picture data before color-gamut compression (L*_in, C*_in, h_in) It carries out. the value of the color picture data after color-gamut compression as (L*_out, C*_out, h_out) In the 2nd field of the above, the field besides the color-reproduction range of an output system is received. Two points (L*_min, 0, h_in), (L*_in, C*_in, h_in) The maximum of the color-reproduction range of the above-mentioned output system on the straight line along which it passes as (L*_p, C*_p, h_in) Compression to the direction of a point (L*_min, 0, h_in) made into L*_out=L*_pC*_out=C*_ph_out=h_in is performed. in the 3rd field of the above They are two points (L*_max, 0, h_in) to the field besides the color-reproduction range of an output system (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the above-mentioned output system on the straight line along which it passes as (L*_p, C*_p, h_in) Compression to the direction of a point (L*_max, 0, h_in) made into L*_out=L*_pC*_out=C*_ph_out=h_in is performed. further in the 4th field They are two points (L*_th, C*_th, h_in) to the field besides the color-reproduction range of an output system (L*_in, C*_in, h_in). The maximum of the color-reproduction range of the above-mentioned output system on the straight line along which it passes as (L*_p, C*_p, h_in) Point made into L*_out=L*_pC*_out=C*_pnh_out=h_in (L*_th, C*_th, h_in) Since compression to a direction is performed It can compress to save saturation if possible in a high lightness field, i.e., the 2nd field, and a low lightness field, i.e., the 3rd field, and to maintain gradation nature to some extent in a high saturation field, i.e., the 4th field, and the discontinuity in the boundary by field division does not exist, either. Where it followed, for example, color-reproduction nature is secured for the above-mentioned CIE/L* C* h color space as a common color space in a color DTP system, color-gamut compression can be performed.

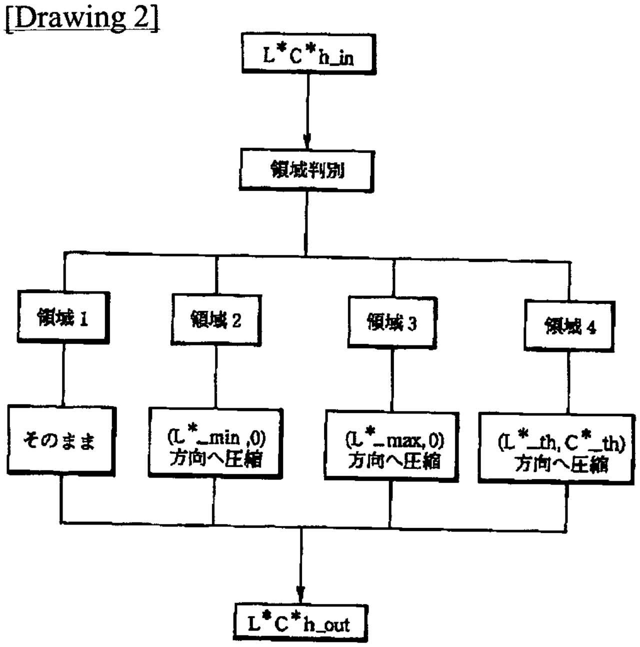
[Translation done.]

DRAWINGS

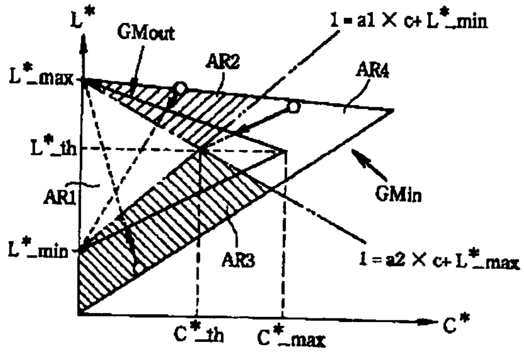
[Drawing 1]



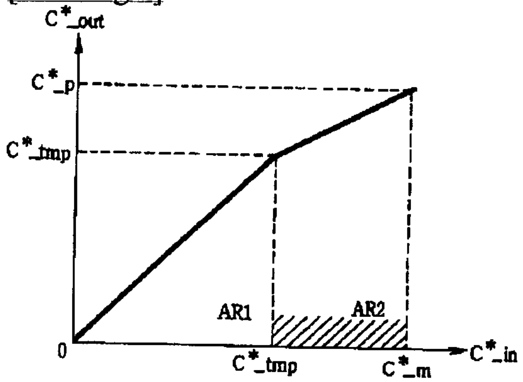
[Drawing 2]



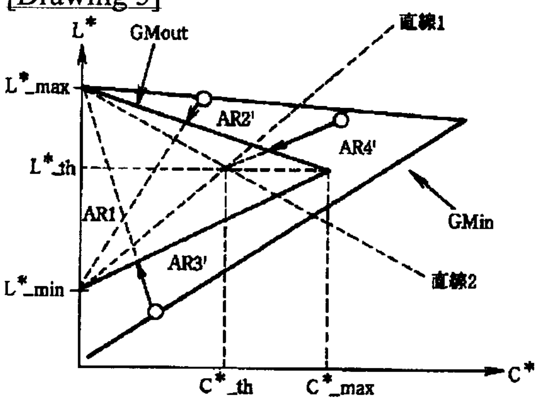
[Drawing 3]



[Drawing 4]



[Drawing 5]



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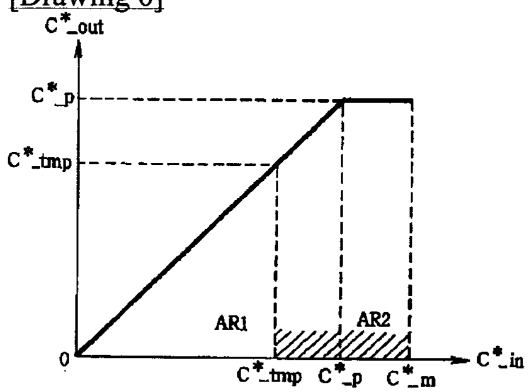
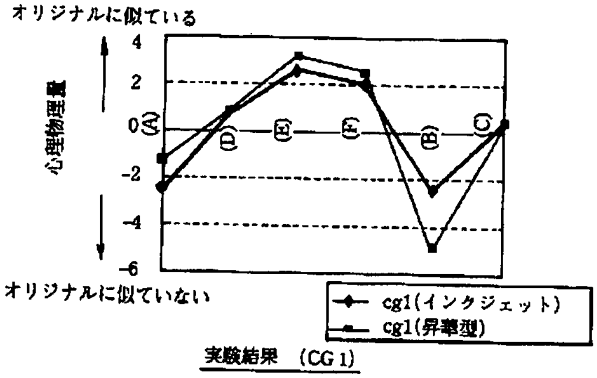
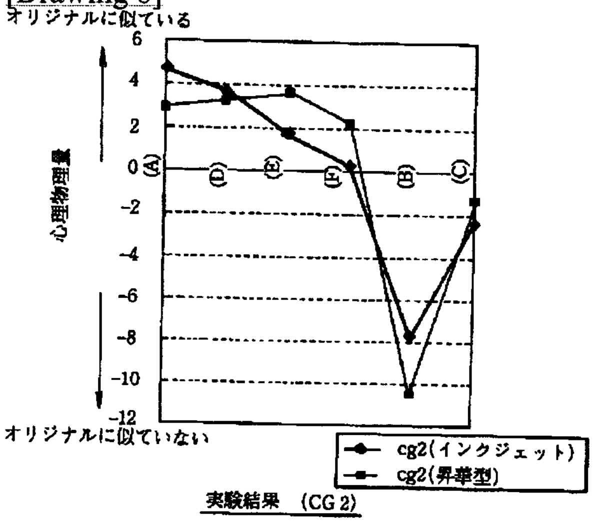


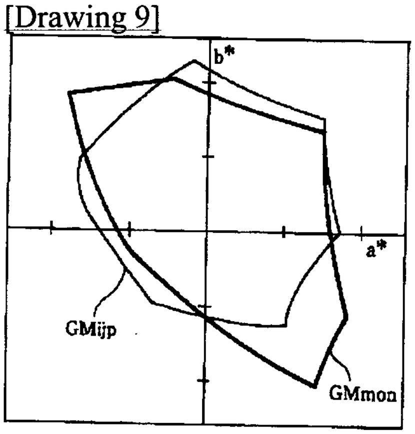
[Drawing 7]



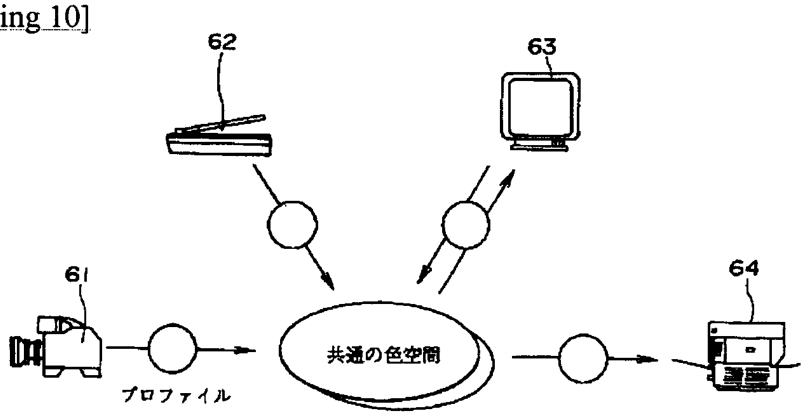
[Drawing 8]



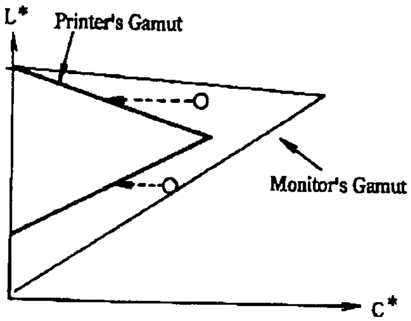
[Drawing 9]



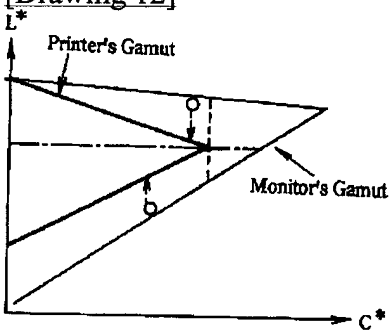
[Drawing 10]



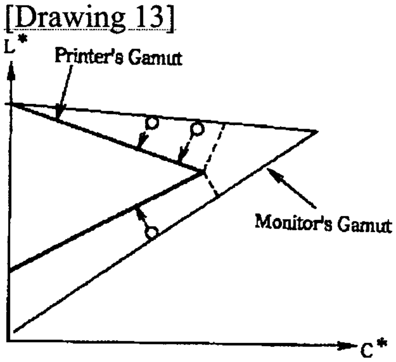
[Drawing 11]



[Drawing 12]



[Drawing 13]



[Translation done.]

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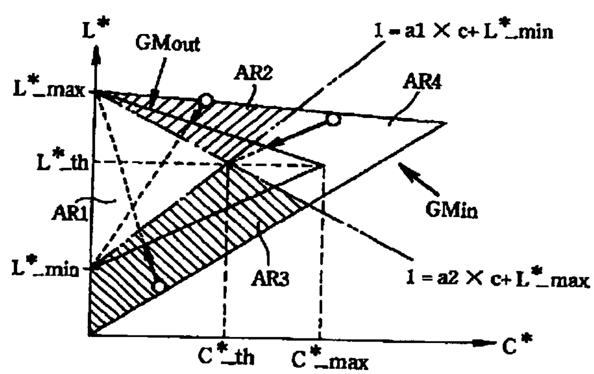
(54)【発明の名称】　色域圧縮方法及び色域圧縮装置

(57)【要約】
【課題】　カラーDTPシステムにおいて、各デバイスの色再現範囲の違いを考慮してより自然な色再現ができるようにした色域圧縮方法及び色域圧縮装置を提供する。
【解決手段】　出力系の色再現範囲GMout が入力系の色再現範囲GMinよりも小さい場合に、色相hを一定の下に、明度L^*と彩度C^*の2次元平面上において2直線を用いて入力系の色再現領域を4分割し、それぞれの領域AR1，AR2，AR3，AR4毎に圧縮方向を変化させて色域圧縮を行い、入力系の色再現範囲GMinの色を出力系の色再現範囲GMout の色に変換する。



(ただし、$C^*\_th = C^*\_max \times K[const]$)

【特許請求の範囲】

【請求項１】　出力系の色再現範囲が入力系の色再現範囲よりも小さい場合に、色相を一定の下に、明度と彩度の２次元平面上において２直線を用いて入力系の色再現領域を４分割し、それぞれの領域毎に圧縮方向を変化させて色域圧縮を行い、入力系の色再現範囲の色を出力系の色再現範囲の色に変換することを特徴とする色域圧縮方法。

【請求項２】　１パラメータを決定することによって、上記２直線の傾きを変化させ、各領域毎の圧縮方向を設定することを特徴する請求項１記載の色域圧縮方法。

【請求項３】ＣＩＥ／L^* C^* ｈ色空間のカラー画像データについて、色相ｈを一定の下、明度L^* と彩度C^* の２次元平面上において、

出力系の色再現範囲の彩度最大値C^*_max を有する明度値L^*_th上の点（C^*_th, L^*_th）で互いに交差し、上記出力系の色再現範囲の明度L^* の最小値L^*_min を通る第１の直線と、上記出力系の色再現範囲の明度L^* の最大値L^*_maxを通る第２の直線で入力系の色再現領域を４分割し、

上記第１の直線より上で第２の直線より下の第１の領域の色はそのままとし、

上記第１の直線及び第２の直線より上の第２の領域の色は点（０，L^*_min ）方向に圧縮し、

上記第１の直線及び第２の直線より下の第３の領域の色は点（０，L^*_max ）方向に圧縮し、

上記第１の直線より下で第２の直線より上の第４の領域の色は点（C^*_th, L^*_th）方向に圧縮することを特徴とする請求項１記載の色域圧縮方法。

【請求項４】　C^*_th＝C^*_max ×Ｋとし、

$0 \leqq K \leqq 1$なるパラメータＫによって、上記点（C^*_th, L^*_th）を移動することにより、上記第１の直線及び第２の直線の各傾きを変化させ、各領域毎の圧縮方向を設定することを特徴する請求項３記載の色域圧縮方法。

【請求項５】　色域圧縮前のカラー画像データの値を（L^*_in, C^*_in, h_in）とし、色域圧縮後のカラー画像データの値を（L^*_out, C^*_out, h_out）として、

上記第２の領域では、２点（L^*_min, ０，h_in），（L^*_in, C^*_in, h_in）を通る直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_m, C^*_m, h_in），（L^*_p, C^*_p, h_in）とし、第１の領域との境界上の値を（L^*_tmp, C^*_tmp, h_in）として、

L^*_out＝L^*_tmp＋（L^*_p－L^*_tmp）／（L^*_m－L^*_tmp）×L^*_in

C^*_out＝C^*_tmp＋（C^*_p－C^*_tmp）／（C^*_m－C^*_tmp）×C^*_in

h_out＝h_in

とする点（L^*_min, ０，h_in）方向への圧縮を行い、また、第３の領域では、２点（L^*_max, ０，h_in），（L^*_in, C^*_in, h_in）を通る直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_m, C^*_m, h_in），（L^*_p, C^*_p, h_in）とし、第１の領域との境界上の値を（L^*_tmp, C^*_tmp, h_in）として、

L^*_out＝L^*_tmp－（L^*_p－L^*_tmp）／（L^*_m－L^*_tmp）×L^*_in

C^*_out＝C^*_tmp＋（C^*_p－C^*_tmp）／（C^*_m－C^*_tmp）×C^*_in

h_out＝h_in

とする点（L^*_max, ０，h_in）方向への圧縮を行い、さらに、第４の領域では、２点（L^*_th, C^*_th, h_in），（L^*_in, C^*_in, h_in）を通る直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_m, C^*_m, h_in）、（L^*_p, C^*_p, h_in）して、

L^*_out＝L^*_th＋（L^*_p－L^*_th）／（L^*_m－L^*_th）×L^*_in

C^*_out＝C^*_th＋（C^*_p－C^*_th）／（C^*_m－C^*_th）×C^*_in

h_out＝h_in

とする点（L^*_th, C^*_th, h_in）方向への圧縮を行うことを特徴とする請求項３記載の色域圧縮方法。

【請求項６】　色域圧縮前のカラー画像データの値を（L^*_in, C^*_in, h_in）とし、色域圧縮後のカラー画像データの値を（L^*_out, C^*_out, h_out）として、

上記第２の領域では、出力系の色再現範囲外の領域に対して、２点（L^*_min, ０，h_in），（L^*_in, C^*_in, h_in）を通る直線上での上記出力系の色再現範囲の最大値を（L^*_p, C^*_p, h_in）として、

L^*_out＝L^*_p

C^*_out＝C^*_p

h_out＝h_in

とする点（L^*_min, ０，h_in）方向への圧縮を行い、また、上記第３の領域では、出力系の色再現範囲外の領域に対して、２点（L^*_max, ０，h_in），（L^*_in, C^*_in, h_in）を通る直線上での上記出力系の色再現範囲の最大値を（L^*_p, C^*_p, h_in）として、

L^*_out＝L^*_p

C^*_out＝C^*_p

h_out＝h_in

とする点（L^*_max, ０，h_in）方向への圧縮を行い、さらに、第４の領域では、出力系の色再現範囲外の領域に対して、２点（L^*_th, C^*_th, h_in），（L^*_in, C^*_in, h_in）を通る直線上での上記出力系の色再現範囲の最大値を（L^*_p, C^*_p, h_in）として、

L^*_out＝L^*_p

C^*_out＝C^*_pn

$h_{out}=h_{in}$
とする点（L^*_{th}, C^*_{th}, h_{in}） 方向への圧縮を行うことを特徴とする請求項３記載の色域圧縮方法。

【請求項７】 入力カラー画像データについて、色相を一定の下に、明度と彩度の２次元平面上において２直線を用いて入力系の色再現領域を４分割した各領域のどの領域に属するかを判別する領域判別手段と、
出力系の色再現範囲外の色を該出力系の色再現範囲の色に変換する色域圧縮を上記領域判別手段で判別された領域毎に圧縮方向を変化させて行う色域圧縮手段とを備えることを特徴とする色域圧縮装置。

【請求項８】 上記領域判別手段は、CIE／L^* C^* h色空間のカラー画像データについて、色相hを一定の下、明度L^* と彩度C^* の２次元平面上において、出力系の色再現範囲の彩度最大値C^*_{max} を有する明度値L^*_{th}上の点（C^*_{th}, L^*_{th}）で互いに交差し、上記出力系の色再現範囲の明度L^* の最小値L^*_{min} を通る第１の直線と、上記出力系の色再現範囲の明度L^* の最大値L^*_{max} を通る第２の直線で入力系の色再現領域を４分割した各領域の領域に属するかを判別し、
上記色域圧縮手段は、上記領域判別手段による判別結果に基づいて、上記第１の直線より上で第２の直線より下の第１の領域の色はそのままとし、上記第１の直線及び第２の直線より上の第２の領域の色は点（０，L^*_{min} ）方向に圧縮し、上記第１の直線及び第２の直線より下の第３の領域の色は点（０，L^*_{max} ）方向に圧縮し、上記第１の直線より下で第２の直線より上の第４の領域の色は点（C^*_{th}, L^*_{th}）方向に圧縮することを特徴とする請求項７記載の色域圧縮装置。

【請求項９】 上記色域圧縮手段は、
色域圧縮前のカラー画像データの値を（L^*_{in}, C^*_{in}, h_{in}） とし、色域圧縮後のカラー画像データの値を（L^*_{out}, C^*_{out}, h_{out}）として、
上記第２の領域では、２点（L^*_{min}, ０, h_{in}），（L^*_{in}, C^*_{in}, h_{in}） を通る直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_{m}, C^*_{m}, h_{in}），（L^*_{p}, C^*_{p}, h_{in}）とし、第１の領域との境界上の値を（L^*_{tmp}, C^*_{tmp}, h_{in}）として、
$L^*_{out}=L^*_{tmp}+(L^*_{p}-L^*_{tmp})/(L^*_{m}-L^*_{tmp})\times L^*_{in}$
$C^*_{out}=C^*_{tmp}+(C^*_{p}-C^*_{tmp})/(C^*_{m}-C^*_{tmp})\times C^*_{in}$
$h_{out}=h_{in}$
とする点（L^*_{min}, ０, h_{in}）方向への圧縮を行い、
また、第３の領域では、２点（L^*_{max}, ０, h_{in}），（L^*_{in}, C^*_{in}, h_{in}） を通る直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_{m}, C^*_{m}, h_{in}），（L^*_{p}, C^*_{p}, h_{in}）とし、第１の領域との境界上の値を（L^*_{tmp}, C^*_{tmp}, h_{in}） として、
$L^*_{out}=L^*_{tmp}-(L^*_{p}-L^*_{tmp})/(L^*_{m}-L^*_{tmp})\times L^*_{in}$
$C^*_{out}=C^*_{tmp}+(C^*_{p}-C^*_{tmp})/(C^*_{m}-C^*_{tmp})\times C^*_{in}$
$h_{out}=h_{in}$
とする点（L^*_{max}, ０, h_{in}）方向への圧縮を行い、
さらに、第４の領域では、２点（L^*_{th}, C^*_{th}, h_{in}），（L^*_{in}, C^*_{in}, h_{in}） を通る直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_{m}, C^*_{m}, h_{in}）、（L^*_{p}, C^*_{p}, h_{in}）して、
$L^*_{out}=L^*_{th}+(L^*_{p}-L^*_{th})/(L^*_{m}-L^*_{th})\times L^*_{in}$
$C^*_{out}=C^*_{th}+(C^*_{p}-C^*_{th})/(C^*_{m}-C^*_{th})\times C^*_{in}$
$h_{out}=h_{in}$
とする点（L^*_{th}, C^*_{th}, h_{in}） 方向への圧縮を行うことを特徴とする請求項８記載の色域圧縮装置。

【請求項１０】 上記色域圧縮手段は、
色域圧縮前のカラー画像データの値を（L^*_{in}, C^*_{in}, h_{in}）とし、色域圧縮後のカラー画像データの値を（L^*_{out}, C^*_{out}, h_{out}）として、
上記第２の領域では、出力系の色再現範囲外の領域に対して、２点（L^*_{min}, ０, h_{in}），（L^*_{in}, C^*_{in}, h_{in}） を通る直線上での上記出力系の色再現範囲の最大値を（L^*_{p}, C^*_{p}, h_{in}）として、
$L^*_{out}=L^*_{p}$
$C^*_{out}=C^*_{p}$
$h_{out}=h_{in}$
とする点（L^*_{min}, ０, h_{in}）方向への圧縮を行い、
また、上記第３の領域では、出力系の色再現範囲外の領域に対して、２点（L^*_{max}, ０, h_{in}），（L^*_{in}, C^*_{in}, h_{in}） を通る直線上での上記出力系の色再現範囲の最大値を（L^*_{p}, C^*_{p}, h_{in}）として、
$L^*_{out}=L^*_{p}$
$C^*_{out}=C^*_{p}$
$h_{out}=h_{in}$
とする点（L^*_{max}, ０, h_{in}）方向への圧縮を行い、
さらに、第４の領域では、出力系の色再現範囲外の領域に対して、２点（L^*_{th}, C^*_{th}, h_{in}），（L^*_{in}, C^*_{in}, h_{in}）を通る直線上での上記出力系の色再現範囲の最大値を（L^*_{p}, C^*_{p}, h_{in}）として、
$L^*_{out}=L^*_{p}$
$C^*_{out}=C^*_{pn}$
$h_{out}=h_{in}$
とする点（L^*_{th}, C^*_{th}, h_{in}） 方向への圧縮を行うことを特徴とする請求項８記載の色域圧縮装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】画像入出力システム一般、例

えば、ワークステーションを中心としたデスクトップパブリッシング(DTP:Desk Top Publishing) システム等に設けて好適なカラー画像データの色域圧縮処理を行う色域圧縮方法及び色圧縮装置に関する。

【0002】

【従来の技術】一般に、カラー画像を扱うデバイスの色域すなわち色の再現範囲(Gamut) の形状は、デバイス毎に異なる。モニタは赤（R），緑（G），青（B）の３原色の蛍光体の発色により加色混合で色再現を行うので、モニタの色再現範囲(Gamut)は使用する蛍光体の種類によって決定される。一方、プリンタはインクのシアン（C），マゼンダ（M），イエロー（Y），黒（K）で色再現を行っているのだが、プリンタの色再現範囲(Gamut) は使用するインクだけでなく、画像の記録媒体となる紙の種類や階調の再現形式によって異なっている。

【0003】例えば、コンピュータグラフィック(CG:Computer Graphic) モニタの色の再現範囲とインクジェットプリンタの色再現範囲を a^*-b^* 平面上で L^* 方向に積分した結果を図９に示してあるように、プリンタの色再現範囲ＧＭijp はモニタの色再現範囲ＧＭmon よりも小さく、特に緑（G）や青（B）の高彩度領域は再現性が非常に悪い。また、上記図９にはあまり差の出ていない他の色相においても彩度のピークが明度方向でずれている。このため、モニタからプリンタへの色再現を考えた場合、高明度、高彩度領域での再現性が特に良くない。

【0004】また、自然画は、彩度の高い色の出現する頻度は少なく、どちらかというと無彩色領域に近い色が多いのであるが、ＣＧ画像は、モニタを出力として描かれているので、プリンタでは再現できないような彩度の高い色を使用していることが多い。そのため、ＣＧ画像は、プリンタで出力しようとしても色再現範囲外の色の割合が多いので、自然画をプリントするときと比較してかなり再現性が悪い。

【0005】従来、カラー画像を扱うデバイスは、画像情報として赤（R），緑（G），青（B）又は輝度（Y）と色差（U），（V）・（I），（Q）などを取扱うカメラとモニタや、シアン（C），マゼンダ（M），イエロー（Y），黒（K）又は赤（Dr），緑（Dg），青（Db）などを取扱うスキャナとプリンタなどのように、特定の入出力デバイスを接続して使用される環境下にあった。このような使用環境下では、入出力デバイス間のみのクローズドな色補正が行われており、色域圧縮(Gamut Compression) の手法もその入出力デバイスの色域すなわち色の再現範囲(Gamut)のみにより決定することができた。

【0006】ところが、カラーＤＴＰシステムのように多くのユーザが様々なデバイスを接続する環境下においては、入出力デバイス間のクローズドな色補正では対応できなくなってしまう。

【0007】そこで、各種入出力デバイスにおいても同じような色で再現しようというデバイスに依存しない色再現技術(Device Independent Color)の概念が要求されるようなってきている。このデバイスに依存しない色再現技術(Device IndependentColor)を実現するためのシステムのことを一般的にカラーマネージメントシステム(CMS:Color Management System) と呼んでいる。

【0008】このＣＭＳは、例えば図１０に示すように、カメラ６１やスキャナ６２、モニタ６３、プリンタ６４などの各種入出力デバイスを接続するに当たり、入力系の色信号から出力系の信号へ変換するときに、プロファイルと呼ばれる変換式若しくは変換テーブルによりデバイスに依存しない共通の色空間（例えばＣＩＥ／ＸＹＺやＣＩＥ／$L^*a^*b^*$ 等）に一度変換することによって実現される。

【0009】上記ＣＭＳにおいて、出力系の色再現範囲が入力系の色再現範囲よりも大きい場合には、そのまま出力できるので問題にならないが、逆に、入力系の色再現範囲が出力系の色再現範囲よりも大きい場合には、画像によっては色情報をそのまま正確に再現することはできない。例えば、モニタ上の画像をプリンタに出力する場合に、モニタよりもプリンタの色再現範囲の方が小さいので、再現範囲外の色はそのままでは再現できない。従って、このような場合には、元の画像情報（階調性や色合い等）をなるべく保ちつつ、色再現範囲外の色を色再現範囲内にもってくるような色修正処理が必要になる。このように物理的に再現不可能な色を何らかの処理により色再現範囲内に押し込むことを一般的に色域圧縮(Gamut Compression) と呼んでいる。

【0010】ここで、人間の色に対する知覚には、色の明るさを表す明度(lightness) 、色の鮮やかさを表す彩度(chroma)、色の系統を表す色相(hue) の３属性がある。この人間の知覚の３属性に基づいた色空間としてＣＩＥ／L^*C^*h 色空間がある。L^* は明度、C^* は彩度、ｈは色相を表しており、この３属性を独立したパラメータとして取り扱うことができる。

【0011】上記色域圧縮(Gamut Compression) は、ＣＩＥ／L^*C^*h 色空間において行うのが知覚的に分かり易く、一般的に色相(hue：h)を一定にして、明度(lightness：L^*)と彩度(chroma：C^*)の２次元平面上で行うのがよいと言われている。

【0012】従来、色域圧縮(Gamut Compression) の手法としては、図１１に示すように明度 L^* を一定にして彩度 C^* だけを圧縮する彩度圧縮法や、図１２に示すように彩度 C^* を一定にして明度 L^* 方向に圧縮する明度圧縮法、図１３に示すように L^*-C^* 平面上で色差を最小にする色差最小法などが知られている。

【0013】

【発明が解決しようとする課題】ところで、従来より知られている彩度圧縮法では、高彩度領域の階調性はある

程度保たれるが、全体的に色味の無い画像になってしまうことがある。

【0014】また、明度圧縮法では、彩度の低下はほとんどないが、高明度領域は低明度へ低明度領域は高明度へ圧縮しているので、彩度が高くなるほど明度差が極端になってしまい、図12中に斜線を施して示す領域は全て同一の色になってしまう。

【0015】さらに、色差最小法では、色差が最小になるため、数学的には最もオリジナルな画像と近い画像となるが、図13中に斜線を施して示す領域には全て同一の色になってしまう。

【0016】そこで、本発明の目的は、上述の如き従来の実情に鑑み、カラーDTPシステムにおいて、各デバイスの色再現範囲の違いを考慮してより自然な色再現ができるようにした色域圧縮方法及び色域圧縮装置を提供することにある。

【0017】

【課題を解決するための手段】本発明に係る色域圧縮方法は、出力系の色再現範囲が入力系の色再現範囲よりも小さい場合に、色相を一定の下に、明度と彩度の２次元平面上において２直線を用いて入力系の色再現領域を４分割し、それぞれの領域毎に圧縮方向を変化させて色域圧縮を行い、入力系の色再現範囲の色を出力系の色再現範囲の色に変換することを特徴とする

また、本発明に係る色域圧縮方法は、１パラメータを決定することによって、上記２直線の傾きを変化させ、各領域毎の圧縮方向を設定することを特徴する。

【0018】また、本発明に係る色域圧縮方法では、例えば、ＣＩＥ／L^* C^* ｈ色空間のカラー画像データについて、色相ｈを一定の下、明度L^* と彩度C^* の２次元平面上において、出力系の色再現範囲の彩度最大値C^*_{max} を有する明度値L^*_{th}上の点（C^*_{th}, L^*_{th}）で互いに交差し、上記出力系の色再現範囲の明度L^*の最小値L^*_{min} を通る第１の直線と、上記出力系の色再現範囲の明度L^* の最大値L^*_{max} を通る第２の直線で入力系の色再現領域を４分割し、上記第１の直線より上で第２の直線より下の第１の領域の色はそのままとし、上記第１の直線及び第２の直線より上の第２の領域の色は点（0，L^*_{min} ）方向に圧縮し、上記第１の直線及び第２の直線より下の第３の領域の色は点（0，L^*_{max} ）方向に圧縮し、上記第１の直線より下で第２の直線より上の第４の領域の色は点（C^*_{th}, L^*_{th}）方向に圧縮する。

【0019】また、本発明に係る色域圧縮方法では、例えば、$C^*_{th}=C^*_{max}\times K$とし、$0\leq K\leq 1$なるパラメータＫによって、上記点（$C^*_{th}$, L^*_{th}）を移動することにより、上記第１の直線及び第２の直線の各傾きを変化させ、各領域毎の圧縮方向を設定する。

【0020】また、さらに、本発明に係る色域圧縮方法では、例えば、色域圧縮前のカラー画像データの値を（L^*_{in}, C^*_{in}, h_{in}） とし、色域圧縮後のカラー画像データの値を（L^*_{out}, C^*_{out}, h_{out}）として、上記第２の領域では、２点（L^*_{min}, 0, h_{in}），（L^*_{in}, C^*_{in}, h_{in}） を通る直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_m, C^*_m, h_{in}），（L^*_p, C^*_p, h_{in}）とし、第１の領域との境界上の値を（L^*_{tmp}, C^*_{tmp}, h_{in}）として、

$L^*_{out}=L^*_{tmp}+(L^*_p-L^*_{tmp})/(L^*_m-L^*_{tmp})\times L^*_{in}$

$C^*_{out}=C^*_{tmp}+(C^*_p-C^*_{tmp})/(C^*_m-C^*_{tmp})\times C^*_{in}$

$h_{out}=h_{in}$

とする点（L^*_{min}, 0, h_{in}）方向への圧縮を行い、また、第３の領域では、２点（L^*_{max}, 0, h_{in}），（L^*_{in}, C^*_{in}, h_{in}） を通る直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_m, C^*_m, h_{in}），（L^*_p, C^*_p, h_{in}）とし、第１の領域との境界上の値を（L^*_{tmp}, C^*_{tmp}, h_{in}） として、

$L^*_{out}=L^*_{tmp}-(L^*_p-L^*_{tmp})/(L^*_m-L^*_{tmp})\times L^*_{in}$

$C^*_{out}=C^*_{tmp}+(C^*_p-C^*_{tmp})/(C^*_m-C^*_{tmp})\times C^*_{in}$

$h_{out}=h_{in}$

とする点（L^*_{max}, 0, h_{in}）方向への圧縮を行い、さらに、第４の領域では、２点（L^*_{th}, C^*_{th}, h_{in}），（L^*_{in}, C^*_{in}, h_{in}） を通る直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_m, C^*_m, h_{in}）、（L^*_p, C^*_p, h_{in}）して、

$L^*_{out}=L^*_{th}+(L^*_p-L^*_{th})/(L^*_m-L^*_{th})\times L^*_{in}$

$C^*_{out}=C^*_{th}+(C^*_p-C^*_{th})/(C^*_m-C^*_{th})\times C^*_{in}$

$h_{out}=h_{in}$

とする点（L^*_{th}, C^*_{th}, h_{in}） 方向への圧縮を行う．さらに、本発明に係る色域圧縮方法では、例えば、色域圧縮前のカラー画像データの値を（L^*_{in}, C^*_{in}, h_{in}） とし、色域圧縮後のカラー画像データの値を（L^*_{out}, C^*_{out}, h_{out}）として、上記第２の領域では、出力系の色再現範囲外の領域に対して、２点（L^*_{min}, 0, h_{in}），（L^*_{in}, C^*_{in}, h_{in}）を通る直線上での上記出力系の色再現範囲の最大値を（L^*_p, C^*_p, h_{in}）として、

$L^*_{out}=L^*_p$

$C^*_{out}=C^*_p$

$h_{out}=h_{in}$

とする点（L^*_{min}, 0, h_{in}）方向への圧縮を行い、また、上記第３の領域では、出力系の色再現範囲外の領域に対して、２点（L^*_{max}, 0, h_{in}），（L^*_{in},

C^*_in, h_in）を通る直線上での上記出力系の色再現範囲の最大値を（L^*_p, C^*_p, h_in）として、

L^*_out＝L^*_p

C^*_out＝C^*_p

h_out＝h_in

とする点（L^*_max, ０, h_in）方向への圧縮を行い、さらに、第４の領域では、出力系の色再現範囲外の領域に対して、２点（L^*_th, C^*_th, h_in），（L^*_in, C^*_in, h_in）を通る直線上での上記出力系の色再現範囲の最大値を（L^*_p, C^*_p, h_in）として、

L^*_out＝L^*_p

C^*_out＝C^*_pn

h_out＝h_in

とする点（L^*_th, C^*_th, h_in）方向への圧縮を行う。

【００２１】本発明に係る色域圧縮装置は、入力カラー画像データについて、色相を一定の下に、明度と彩度の２次元平面上において２直線を用いて入力系の色再現領域を４分割した各領域のどの領域に属するかを判別する領域判別手段と、出力系の色再現範囲外の色を該出力系の色再現範囲の色に変換する色域圧縮を上記領域判別手段で判別された領域毎に圧縮方向を変化させて行う色域圧縮手段とを備えることを特徴とする。

【００２２】本発明に係る色域圧縮装置において、上記領域判別手段は、例えば、ＣＩＥ／L^* C^* ｈ色空間のカラー画像データについて、色相ｈを一定の下、明度L^*と彩度C^*の２次元平面上において、出力系の色再現範囲の彩度最大値C^*_max を有する明度値L^*_th上の点（C^*_th, L^*_th）で互いに交差し、上記出力系の色再現範囲の明度L^*の最小値L^*_min を通る第１の直線と、上記出力系の色再現範囲の明度L^*の最大値L^*_max を通る第２の直線で入力系の色再現領域を４分割した各領域の領域に属するかを判別し、また、上記色域圧縮手段は、上記領域判別手段による判別結果に基づいて、上記第１の直線より上で第２の直線より下の第１の領域の色はそのままとし、上記第１の直線及び第２の直線より上の第２の領域の色は点（０, L^*_min ）方向に圧縮し、上記第１の直線及び第２の直線より下の第３の領域の色は点（０, L^*_max ）方向に圧縮し、上記第１の直線より下で第２の直線より上の第４の領域の色は点（C^*_th, L^*_th）方向に圧縮する。

【００２３】また、本発明に係る色域圧縮装置において、上記色域圧縮手段は、例えば、色域圧縮前のカラー画像データの値を（L^*_in, C^*_in, h_in）とし、色域圧縮後のカラー画像データの値を（L^*_out, C^*_out, h_out）として、上記第２の領域では、２点（L^*_min, ０, h_in），（L^*_in, C^*_in, h_in）を通る直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_m, C^*_m, h_in），（L^*_p, C^*_p, h_in）とし、第１の領域との境界上の値を（L^*_tmp, C^*_tmp, h_in）として、

L^*_out＝L^*_tmp＋（L^*_p－L^*_tmp）／（L^*_m－L^*_tmp）×L^*_in

C^*_out＝C^*_tmp＋（C^*_p－C^*_tmp）／（C^*_m－C^*_tmp）×C^*_in

h_out＝h_in

とする点（L^*_min, ０, h_in）方向への圧縮を行い、また、第３の領域では、２点（L^*_max, ０, h_in），（L^*_in, C^*_in, h_in）を通る直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_m, C^*_m, h_in），（L^*_p, C^*_p, h_in）とし、第１の領域との境界上の値を（L^*_tmp, C^*_tmp, h_in）として、

L^*_out＝L^*_tmp－（L^*_p－L^*_tmp）／（L^*_m－L^*_tmp）×L^*_in

C^*_out＝C^*_tmp＋（C^*_p－C^*_tmp）／（C^*_m－C^*_tmp）×C^*_in

h_out＝h_in

とする点（L^*_max, ０, h_in）方向への圧縮を行い、さらに、第４の領域では、２点（L^*_th, C^*_th, h_in），（L^*_in, C^*_in, h_in）を通る直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_m, C^*_m, h_in）、（L^*_p, C^*_p, h_in）して、

L^*_out＝L^*_th＋（L^*_p－L^*_th）／（L^*_m－L^*_th）×L^*_in

C^*_out＝C^*_th＋（C^*_p－C^*_th）／（C^*_m－C^*_th）×C^*_in

h_out＝h__ｉｎ

とする点（L^*__ｔｈ, C^*_th, h_in）方向への圧縮を行う。

【００２４】さらに、本発明に係る色域圧縮装置において、上記色域圧縮手段は、例えば、色域圧縮前のカラー画像データの値を（L^*_in, C^*_in, h_in）とし、色域圧縮後のカラー画像データの値を（L^*_out, C^*_out, h_out）として、上記第２の領域では、出力系の色再現範囲外の領域に対して、２点（L^*_min, ０, h_in），（L^*_in, C^*_in, h_in）を通る直線上での上記出力系の色再現範囲の最大値を（L^*_p, C^*_p, h_in）として、

L^*_out＝L^*_p

C^*_out＝C^*_p

h_out＝h_in

とする点（L^*_min, ０, h_in）方向への圧縮を行い、また、上記第３の領域では、出力系の色再現範囲外の領域に対して、２点（L^*_max, ０, h_in），（L^*_in, C^*_in, h_in）を通る直線上での上記出力系の色再現範囲の最大値を（L^*_p, C^*_p, h_in）として、

L^*_out＝L^*_p

C^*_out＝C^*_p

h_out＝h_in

とする点（L^*_max，０，ｈ_in）方向への圧縮を行い、さらに、第４の領域では、出力系の色再現範囲外の領域に対して、２点（L^*_th，C^*_th，ｈ_in），（L^*_in，C^*_in，ｈ_in）を通る直線上での上記出力系の色再現範囲の最大値を（L^*_p，C^*_p，ｈ_in）として、

L^*_out＝L^*_p

C^*_out＝C^*_pn

ｈ_out＝ｈ_in

とする点（L^*_th，C^*_th，ｈ_in）方向への圧縮を行う。

【００２５】

【発明の実施の形態】以下、本発明の実施の形態について図面を参照しながら説明する。

【００２６】本発明は、例えば図１に示すような構成のカラーマネージメントシステム(CMS:Color Management System)において実施される。

【００２７】この図１に示したＣＭＳは、入力系のデバイス１とカラー画像入力部２と画像処理部３とカラー画像出力部４と出力系のデバイス５からなる基本的な構成のものであって、入力系のデバイス１からカラー画像入力部２を介してカラー画像データが入力される画像処理部３において、上記カラー画像データに共通の色空間で色再現領域圧縮処理(Gamut Compression) を施し、この色再現領域圧縮処理済みのカラー画像データを上記画像処理部３からカラー画像出力部４を介して出力系のデバイス５に出力するようになっている。

【００２８】上記画像処理部３は、入力側変換部３１と色再現領域圧縮処理部３２と出力側変換部３３からなる。上記入力側変換部３１は、入力系のデバイス１からカラー画像入力部２を介して入力されるカラー画像データすなわち上記入力系のデバイス１の色域に依存した入力系の色空間のカラー画像データを上記入力系のデバイス１の色域に依存しない共通の色空間例えばＣＩＥ／L^*C^*ｈ色空間のカラー画像データに変換する。また、上記色再現領域圧縮処理部３２は、上記入力側変換部３１を介して供給されるＣＩＥ／L^*C^*ｈ色空間のカラー画像データに色再現領域圧縮処理を施す。そして、上記出力側変換部３３は、上記色再現領域圧縮処理部３２により色再現領域圧縮処理が施された上記ＣＩＥ／L^*C^*ｈ色空間のカラー画像データを出力系のデバイス５の色域に依存した出力系の色空間のカラー画像データに変換して、カラー画像出力部４を介して上記出力系のデバイス５に出力する。

【００２９】ここで、上記色再現領域圧縮処理部３２では、上記入力側変換部３１を介して供給されるＣＩＥ／L^*C^*ｈ色空間のカラー画像データについて、図２のフローチャートに示す手順に従った色再現領域圧縮処理を行うようになっている。

【００３０】すなわち、上記色再現領域圧縮処理部３２では、ＣＩＥ／L^*C^*ｈ色空間のカラー画像データについて、図３に示すように、色相ｈを一定の下、明度L^*と彩度C^*の２次元平面上において、２直線を用いて入力系の色再現領域ＧＭinを４分割する。

【００３１】上記２直線は、一方の直線が出力系の明度L^*の最小値L^*_min を通り、他方の直線が出力系の明度L^*の最大値L^*_max を通り、ある一点で交差している。ここで、上記２直線の交点は、彩度最大値C^*_max を有する明度値L^*_th上にある。

【００３２】上記２直線は、

ｌ＝ａ１×ｃ＋L^*_min

ｌ＝ａ２×ｃ＋L^*_max

にて表すことができる。上記ａ１，ａ２はそれぞれ上記２直線の傾きであり、

ａ１＝（L^*_th－L^*_min）／C^*th

ａ２＝（L^*_th－L^*_max）／C^*th

である。ここで、上記C^*thは、

C^*th＝C^*_max×Ｋ　（ただし、Ｋは０≦Ｋ≦１なる定数である。）

で決定されるパラメータである。

【００３３】従って、上記入力系の色再現領域ＧＭinは次のように４分割される。

【００３４】

第１の領域ＡＲ１：ａ１×ｃ＋L^*_min≦ｌ≦ａ２×ｃ＋L^*_max

第２の領域ＡＲ２：ｌ≧ａ１×ｃ＋L^*_min，ｌ≧ａ２×ｃ＋L^*_max

第３の領域ＡＲ３：ｌ≦ａ１×ｃ＋L^*_min，ｌ≦ａ２×ｃ＋L^*_max

第４の領域ＡＲ４：ａ２×ｃ＋L^*_max≦ｌ≦ａ１×ｃ＋L^*_min

上記色再現領域圧縮処理部３２では、ＣＩＥ／L^*C^*ｈ色空間に変換されたカラー画像データの値を（L^*_in，C^*_in，ｈ_in）とし、圧縮後のカラー画像データの値を（L^*_out，C^*_out，ｈ_out）として、上記２直線の式にｌ＝L^*_in，ｃ＝C^*_inを代入して、領域の判別を行う。

【００３５】そして、上記色再現領域圧縮処理部３２は、第１の領域ＡＲ１であれば、そのままの値、すなわち、

L^*_out＝L^*_in

C^*_out＝C^*_in

ｈ_out＝ｈ_in

とする。

【００３６】また、第２の領域ＡＲ２であれば、点（L^*_min，０，ｈ_in）方向へ圧縮を行う。この第２の領域ＡＲ２では、図４に示すように、出力系の色再現範囲ＧMout から離れれば離れるほど大きな圧縮率とする。例えば２点（L^*_min，０，ｈ_in），（L^*_in，C^*_in，ｈ_in）を通る直線を考えたとき、この直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_

m, C^*_m, h_in），（L^*_p, C^*_p, h_in）とし、第1の領域AR1との境界上の値を（L^*_tmp, C^*_tmp, h_in）とすると、

L^*_out＝L^*_tmp＋（L^*_p－L^*_tmp）／（L^*_m－L^*_tmp）×L^*_in

C^*_out＝C^*_tmp＋（C^*_p－C^*_tmp）／（C^*_m－C^*_tmp）×C^*_in

h_out＝h_in

とする。

【0037】また、第3領域AR3であれば、点（L^*_max, 0, h_in）方向へ圧縮を行う。この第3の領域AR3では、出力系の色再現範囲GMout から離れれば離れるほど大きな圧縮率とする。例えば、2点（L^*_max, 0, h_in），（L^*_in, C^*_in, h_in） を通る直線を考えたとき、この直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_m, C^*_m, h_in），（L^*_p, C^*_p, h_in）とし、第1の領域AR1との境界上の値を（L^*_tmp, C^*_tmp, h_in） とすると、

L^*_out＝L^*_tmp－（L^*_p－L^*_tmp）／（L^*_m－L^*_tmp）×L^*_in

C^*_out＝C^*_tmp＋（C^*_p－C^*_tmp）／（C^*_m－C^*_tmp）×C^*_in

h_out＝h_in

とする。

【0038】さらに、第4の領域AR4であれば、点（L^*_th, C^*_th, h_in） 方向へ圧縮を行う。この第4の領域AR4では、出力系の色再現範囲GMout から離れれば離れるほど大きな圧縮率とする。例えば、2点（L^*_th, C^*_th, h_in），（L^*_in, C^*_in, h_in） を通る直線を考えたとき、この直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_m, C^*_m, h_in）、（L^*_p, C^*_p, h_in）とすると、

L^*_out＝L^*_th＋（L^*_p－L^*_th）／（L^*_m－L^*_th）×L^*_in

C^*_out＝C^*_th＋（C^*_p－C^*_th）／（C^*_m－C^*_th）×C^*_in

h_out＝h_in

とする。

【0039】このような処理により、高明度領域すなわち第2の領域AR2及び低明度領域すなわち第3の領域AR3においてはなるべく彩度を保存し、また、高彩度領域すなわち第4の領域AR4においてはある程度階調性を保つように圧縮を行うことができる。また、領域分割による境界での不連続性も存在しない。また、パラメータKを大きくすることで彩度方の低下を最小限に防ぐことができ、Kを小さくすることによって明度方向の変化を小さくし、高彩度領域の階調性もよくすることもできる。

【0040】なお、上述の例では、デバイスに依存しない色空間としてCIE／L^* C^* h色空間を用いたが、Huntの色空間やNayataniの色空間などの他の色空間を用いて色域圧縮処理を行うようにしても良い。

【0041】また、上述の例では、出力系の色再現範囲GMout を越える色を含む第2乃至第4の領域AR2，AR3，AR4の全ての色に対して、上記出力系の色再現範囲GMout 内に圧縮する処理を行ったが、例えば図5に示すように、上記第2乃至第4の領域AR2，AR3，AR4で出力系の色再現範囲GMout を越える領域AR2’，AR3’，AR4’の色だけを、上記出力系の色再現範囲GMout内で一番近い色に圧縮するようにしても良い。

【0042】すなわち、図6に示すように、第1の領域AR1の色は、そのままの値、

L^*_out＝L^*_in

C^*_out＝C^*_in

h_out＝h_in

とする。

【0043】そして、第2の領域AR2’では点（L^*_min, 0, h_in）方向へ、第2の領域AR2’では点（L^*_min, 0, h_in）方向へ、第3領域AR3であれば、点（L^*_max, 0, h_in）方向へ、さらに、第4の領域AR4’では点（L^*_th, C^*_th, h_in） 方向へ、それぞれ圧縮して、

L^*_out＝L^*_p

C^*_out＝C^*_p

h_out＝h_in

とする。

【0044】この場合には、収束方向の一致しているグラデーションは同一色になってしまうが、CG画像について視感実験により従来の彩度圧縮法、明度圧縮法、色差最小法と比較したところ、優位性を示す結果が得られた。

【0045】視感実験は、イエローやグリーンを多く含んだ第1の画像CG1とブルーやマゼンダを多く含んだ第2の画像CG2の2種類のCG画像を用い、色域圧縮の手法として従来の彩度圧縮法（A）、明度圧縮法（B）、色差最小法（C）と、上記図5に示した手法でパラメータをK＝0（D），K＝0．75（E），K＝1（F）とした場合について、外光の影響を受けない暗室内において、被験者を中心に90°の位置にモニタとライトボックスを設置し、モニタ上の画像とライトボックスの中に呈示される色域圧縮の手法の異なる2枚の画像を比較して、両者のうちどちらがモニタ上の画像に似ているかを全ての組合せ（6×5／2＝15通り）について33名（男性19名、女性14名）の被験者に判断させた。ライトボックスの中に呈示する画像としては、さインクジェットプリンタ（A3＋、300DPI、コンティニアス方式）と昇華型プリンタ（A4、163D

ＰＩ）の２種類のプリンタの出力画像を用いた。

【００４６】この視感実験により得られた結果を図７及び図８に示す。図７及び図８の各横軸は色域圧縮の手法の違いを示し、縦軸は心理的物理量を表しており、値が大きくなるほど、モニタ上の画像と似ているという結果を示している。

【００４７】すなわち、ＣＧ１に対しては手法（Ｅ），（Ｆ）が良く、ＣＧ２では手法（Ａ），（Ｄ），（Ｆ）が良いという結果が得られた。

【００４８】なお、上記図５に示した手法は、ＣＧ１ではパラメータをＫ＝０．７５（Ｅ）及びＫ＝１（Ｆ）とした場合が良い結果となった。Ｋ＝０（Ｄ）とした場合には、若干の彩度落ちがあり、それが好ましさの低下につながったと思われる。また、ＣＧ２ではパラメータを小さくするほどオリジナルに似ているという結果になった。従って、上記図５に示した手法では、パラメータＫを０．５～１の範囲内に設定すると良い。

【００４９】

【発明の効果】本発明に係る色域圧縮方法では、出力系の色再現範囲が入力系の色再現範囲よりも小さい場合に、色相を一定の下に、明度と彩度の２次元平面上において２直線を用いて入力系の色再現領域を４分割し、それぞれの領域毎に圧縮方向を変化させて色域圧縮を行い、入力系の色再現範囲の色を出力系の色再現範囲の色に変換するので、より自然に見えるように色域圧縮を行うことができる。

【００５０】また、本発明に係る色域圧縮方法では、１パラメータを決定することによって、上記２直線の傾きを変化させ、各領域毎の圧縮方向を設定することができるので、カラーＤＴＰシステムに適用した場合に、入出力デバイスの色再現範囲の違いを考慮してより自然な色再現性を確保した状態で色域圧縮を行うことができる。

【００５１】また、本発明に係る色域圧縮方法では、例えば、ＣＩＥ／L^*C^*h色空間のカラー画像データについて、色相ｈを一定の下、明度L^*と彩度C^*の２次元平面上において、出力系の色再現範囲の彩度最大値C^*_maxを有する明度値L^*_th上の点（C^*_th, L^*_th）で互いに交差し、上記出力系の色再現範囲の明度L^*の最小値L^*_minを通る第１の直線と、上記出力系の色再現範囲の明度L^*の最大値L^*_maxを通る第２の直線で入力系の色再現領域を４分割し、上記第１の直線より上で第２の直線より下の第１の領域の色はそのままとし、上記第１の直線及び第２の直線より上の第２の領域の色は点（０，L^*_min）方向に圧縮し、上記第１の直線及び第２の直線より下の第３の領域の色は点（０，L^*_max）方向に圧縮し、上記第１の直線より下で第２の直線より上の第４の領域の色は点（C^*_th, L^*_th）方向に圧縮するので、高明度領域すなわち第２の領域及び低明度領域すなわち第３の領域においてはなるべく彩度を保存し、また、高彩度領域すなわち第４の領域においてはある程度階調性を保つように圧縮を行うことができ。

【００５２】また、本発明に係る色域圧縮方法では、例えば、$C^*_th＝C^*_max×K$とし、$0≦K≦1$なるパラメータＫによって、上記点（C^*_th, L^*_th）を移動することにより、上記第１の直線及び第２の直線の各傾きを変化させ、各領域毎の圧縮方向を設定することができ、パラメータＫを大きくすることで彩度方の低下を最小限に防ぐことができ、Ｋを小さくすることによって明度方向の変化を小さくし、高彩度領域の階調性もよくすることもできる。

【００５３】また、さらに、本発明に係る色域圧縮方法では、例えば、色域圧縮前のカラー画像データの値を（L^*_in, C^*_in, h_in）とし、色域圧縮後のカラー画像データの値を（L^*_out, C^*_out, h_out）として、上記第２の領域では、２点（L^*_min, ０, h_in），（L^*_in, C^*_in, h_in）を通る直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_m, C^*_m, h_in），（L^*_p, C^*_p, h_in）とし、第１の領域との境界上の値を（L^*_tmp, C^*_tmp, h_in）として、

$L^*\_out＝L^*\_tmp＋(L^*\_p－L^*\_tmp)／(L^*\_m－L^*\_tmp)×L^*\_in$

$C^*\_out＝C^*\_tmp＋(C^*\_p－C^*\_tmp)／(C^*\_m－C^*\_tmp)×C^*\_in$

$h\_out＝h\_in$

とする点（L^*_min, ０, h_in）方向への圧縮を行い、また、第３の領域では、２点（L^*_max, ０, h_in），（L^*_in, C^*_in, h_in）を通る直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_m, C^*_m, h_in），（L^*_p, C^*_p, h_in）とし、第１の領域との境界上の値を（L^*_tmp, C^*_tmp, h_in）として、

$L^*\_out＝L^*\_tmp－(L^*\_p－L^*\_tmp)／(L^*\_m－L^*\_tmp)×L^*\_in$

$C^*\_out＝C^*\_tmp＋(C^*\_p－C^*\_tmp)／(C^*\_m－C^*\_tmp)×C^*\_in$

$h\_out＝h\_in$

とする点（L^*_max, ０, h_in）方向への圧縮を行い、さらに、第４の領域では、２点（L^*_th, C^*_th, h_in），（L^*_in, C^*_in, h_in）を通る直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_m, C^*_m, h_in）、（L^*_p, C^*_p, h_in）して、

$L^*\_out＝L^*\_th＋(L^*\_p－L^*\_th)／(L^*\_m－L^*\_th)×L^*\_in$

$C^*\_out＝C^*\_th＋(C^*\_p－C^*\_th)／(C^*\_m－C^*\_th)×C^*\_in$

$h\_out＝h\_in$

とする点（L^*_th, C^*_th, h_in）方向への圧縮を行うので、高明度領域すなわち第２の領域及び低明度領域すなわち第３の領域においてはなるべく彩度を保存し、

また、高彩度領域すなわち第４の領域においてはある程度階調性を保つように圧縮を行うことができ、また、領域分割による境界での不連続性も存在しない。従って、例えばカラーＤＴＰシステムにおいて、上記ＣＩＥ／$L^* C^* h$色空間を共通の色空間として、色再現性を確保した状態で色域圧縮を行うことができる。

【００５４】さらに、本発明に係る色域圧縮方法では、例えば、色域圧縮前のカラー画像データの値を（L^*_{in}, C^*_{in}, h_{in}）とし、色域圧縮後のカラー画像データの値を（L^*_{out}, C^*_{out}, h_{out}）として、上記第２の領域では、出力系の色再現範囲外の領域に対して、２点（L^*_{min}, ０, h_{in}），（L^*_{in}, C^*_{in}, h_{in}）を通る直線上での上記出力系の色再現範囲の最大値を（L^*_{p}, C^*_{p}, h_{in}）として、

$L^*_{out}=L^*_{p}$

$C^*_{out}=C^*_{p}$

$h_{out}=h_{in}$

とする点（L^*_{min}, ０, h_{in}）方向への圧縮を行い、また、上記第３の領域では、出力系の色再現範囲外の領域に対して、２点（L^*_{max}, ０, h_{in}），（L^*_{in}, C^*_{in}, h_{in}）を通る直線上での上記出力系の色再現範囲の最大値を（L^*_{p}, C^*_{p}, h_{in}）として、

$L^*_{out}=L^*_{p}$

$C^*_{out}=C^*_{p}$

$h_{out}=h_{in}$

とする点（L^*_{max}, ０, h_{in}）方向への圧縮を行い、さらに、第４の領域では、出力系の色再現範囲外の領域に対して、２点（L^*_{th}, C^*_{th}, h_{in}），（L^*_{in}, C^*_{in}, h_{in}）を通る直線上での上記出力系の色再現範囲の最大値を（L^*_{p}, C^*_{p}, h_{in}）として、

$L^*_{out}=L^*_{p}$

$C^*_{out}=C^*_{pn}$

$h_{out}=h_{in}$

とする点（L^*_{th}, C^*_{th}, h_{in}）方向への圧縮を行うので、高明度領域すなわち第２の領域及び低明度領域すなわち第３の領域においてはなるべく彩度を保存し、また、高彩度領域すなわち第４の領域においてはある程度階調性を保つように圧縮を行うことができ、また、領域分割による境界での不連続性も存在しない。従って、例えばカラーＤＴＰシステムにおいて、上記ＣＩＥ／$L^* C^* h$色空間を共通の色空間として、色再現性を確保した状態で色域圧縮を行うことができる。

【００５５】本発明に係る色域圧縮装置では、入力カラー画像データについて、色相を一定の下に、明度と彩度の２次元平面上において２直線を用いて入力系の色再現領域を４分割した各領域のどの領域に属するかを判別する領域判別手段と、出力系の色再現範囲外の色を該出力系の色再現範囲の色に変換する色域圧縮を上記領域判別手段で判別された領域毎に圧縮方向を変化させて行う色域圧縮手段とを備えるので、出力系の色再現範囲が入力系の色再現範囲よりも小さい場合に、より自然に見えるように入力系の色再現範囲の色を出力系の色再現範囲の色に変換する色域圧縮を行うことができる。

【００５６】また、本発明に係る色域圧縮装置では、上記領域判別手段により、例えば、ＣＩＥ／$L^* C^* h$色空間のカラー画像データについて、色相ｈを一定の下、明度L^*と彩度C^*の２次元平面上において、出力系の色再現範囲の彩度最大値C^*_{max}を有する明度値L^*_{th}上の点（C^*_{th}, L^*_{th}）で互いに交差し、上記出力系の色再現範囲の明度L^*の最小値L^*_{min}を通る第１の直線と、上記出力系の色再現範囲の明度L^*の最大値L^*_{max}を通る第２の直線で入力系の色再現領域を４分割した各領域の領域に属するかを判別し、また、上記色域圧縮手段は、上記領域判別手段による判別結果に基づいて、上記第１の直線より上で第２の直線より下の第１の領域の色はそのままとし、上記第１の直線及び第２の直線より上の第２の領域の色は点（０, L^*_{min}）方向に圧縮し、上記第１の直線及び第２の直線より下の第３の領域の色は点（０, L^*_{max}）方向に圧縮し、上記第１の直線より下で第２の直線より上の第４の領域の色は点（C^*_{th}, L^*_{th}）方向に圧縮するので、高明度領域すなわち第２の領域及び低明度領域すなわち第３の領域においてはなるべく彩度を保存し、また、高彩度領域すなわち第４の領域においてはある程度階調性を保つように圧縮を行うことができる。

【００５７】また、本発明に係る色域圧縮装置では、上記色域圧縮手段により、例えば、色域圧縮前のカラー画像データの値を（L^*_{in}, C^*_{in}, h_{in}）とし、色域圧縮後のカラー画像データの値を（L^*_{out}, C^*_{out}, h_{out}）として、上記第２の領域では、２点（L^*_{min}, ０, h_{in}），（L^*_{in}, C^*_{in}, h_{in}）を通る直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_{m}, C^*_{m}, h_{in}），（L^*_{p}, C^*_{p}, h_{in}）とし、第１の領域との境界上の値を（L^*_{tmp}, C^*_{tmp}, h_{in}）として、

$L^*_{out}=L^*_{tmp}+(L^*_{p}-L^*_{tmp})/(L^*_{m}-L^*_{tmp})\times L^*_{in}$

$C^*_{out}=C^*_{tmp}+(C^*_{p}-C^*_{tmp})/(C^*_{m}-C^*_{tmp})\times C^*_{in}$

$h_{out}=h_{in}$

とする点（L^*_{min}, ０, h_{in}）方向への圧縮を行い、また、第３の領域では、２点（L^*_{max}, ０, h_{in}），（L^*_{in}, C^*_{in}, h_{in}）を通る直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_{m}, C^*_{m}, h_{in}），（L^*_{p}, C^*_{p}, h_{in}）とし、第１の領域との境界上の値を（L^*_{tmp}, C^*_{tmp}, h_{in}）として、

$L^*_{out}=L^*_{tmp}-(L^*_{p}-L^*_{tmp})/(L^*_{m}-L^*_{tmp})\times L^*_{in}$

$C^*_{out}=C^*_{tmp}+(C^*_{p}-C^*_{tmp})/(C^*_{m}-C^*$

_tmp）×C^*_in

h_out＝h_in

とする点（L^*_max，０，h_in）方向への圧縮を行い、さらに、第４の領域では、２点（L^*_th，C^*_th，h_in），（L^*_in，C^*_in，h_in）を通る直線上での入力系及び出力系の色再現範囲の最大値をそれぞれ（L^*_m，C^*_m，h_in）、（L^*_p，C^*_p，h_in）して、

L^*_out＝L^*_th＋（L^*_p－L^*_th）／（L^*_m－L^*_th）×L^*_in

C^*_out＝C^*_th＋（C^*_p－C^*_th）／（C^*_m－C^*_th）×C^*_in

h_out＝h_in

とする点（L^*_th，C^*_th，h_in）方向への圧縮を行うので、高明度領域すなわち第２の領域及び低明度領域すなわち第３の領域においてはなるべく彩度を保存し、また、高彩度領域すなわち第４の領域においてはある程度階調性を保つように圧縮を行うことができ、また、領域分割による境界での不連続性も存在しない。従って、例えばカラーＤＴＰシステムにおいて、上記ＣＩＥ／L^*C^*h色空間を共通の色空間として、色再現性を確保した状態で色域圧縮を行うことができる。

【００５８】さらに、本発明に係る色域圧縮装置では、上記色域圧縮手段により、例えば、色域圧縮前のカラー画像データの値を（L^*_in，C^*_in，h_in）とし、色域圧縮後のカラー画像データの値を（L^*_out，C^*_out，h_out）として、上記第２の領域では、出力系の色再現範囲外の領域に対して、２点（L^*_min，０，h_in），（L^*_in，C^*_in，h_in）を通る直線上での上記出力系の色再現範囲の最大値を（L^*_p，C^*_p，h_in）として、

L^*_out＝L^*_p

C^*_out＝C^*_p

h_out＝h_in

とする点（L^*_min，０，h_in）方向への圧縮を行い、また、上記第３の領域では、出力系の色再現範囲外の領域に対して、２点（L^*_max，０，h_in），（L^*_in，C^*_in，h_in）を通る直線上での上記出力系の色再現範囲の最大値を（L^*_p，C^*_p，h_in）として、

L^*_out＝L^*_p

C^*_out＝C^*_p

h_out＝h_in

とする点（L^*_max，０，h_in）方向への圧縮を行い、さらに、第４の領域では、出力系の色再現範囲外の領域に対して、２点（L^*_th，C^*_th，h_in），（L^*_in，C^*_in，h_in）を通る直線上での上記出力系の色再現範囲の最大値を（L^*_p，C^*_p，h_in）として、

L^*_out＝L^*_p

C^*_out＝C^*_pn

h_out＝h_in

とする点（L^*_th，C^*_th，h_in）方向への圧縮を行うので、高明度領域すなわち第２の領域及び低明度領域すなわち第３の領域においてはなるべく彩度を保存し、また、高彩度領域すなわち第４の領域においてはある程度階調性を保つように圧縮を行うことができ、また、領域分割による境界での不連続性も存在しない。従って、例えばカラーＤＴＰシステムにおいて、上記ＣＩＥ／L^*C^*h色空間を共通の色空間として、色再現性を確保した状態で色域圧縮を行うことができる。

【図面の簡単な説明】

【図１】本発明を適用したカラーマネージメントシステムＣＭＳの基本的な構成を示す図である。

【図２】上記ＣＭＳにおける色再現領域圧縮処理部による色再現領域圧縮処理の手順を示すフローチャートである。

【図３】上記色再現領域圧縮処理部による色再現領域圧縮処理の一例を模式的に示す図である。

【図４】上記色再現領域圧縮処理部による色再現領域圧縮処理の一例における第１の領域及び第２の領域に対する色再現領域圧縮処理の内容を模式的に示す図である。

【図５】上記色再現領域圧縮処理部による色再現領域圧縮処理の他の例を模式的に示す図である。

【図６】上記色再現領域圧縮処理部による色再現領域圧縮処理の他の例における第１の領域及び第２の領域の色再現領域圧縮処理の内容を模式的に示す図である。

【図７】上記色再現領域圧縮処理部による色再現領域圧縮処理の他の例と従来の彩度圧縮法による各種手法とを比較する視感実験により得られた結果を示す図である。

【図８】上記色再現領域圧縮処理部による色再現領域圧縮処理の他の例と従来の彩度圧縮法による各種手法とを比較する視感実験により得られた結果を示す図である。

【図９】ＣＧモニタの色の再現範囲とインクジェットプリンタの色再現範囲をa^*-b^*平面上でL^*方向に積分した結果を示す図である。

【図１０】一般的なカラーマネージメントシステムの構成を示す図である。

【図１１】従来の彩度圧縮法による色域圧縮の手法を示す図である。

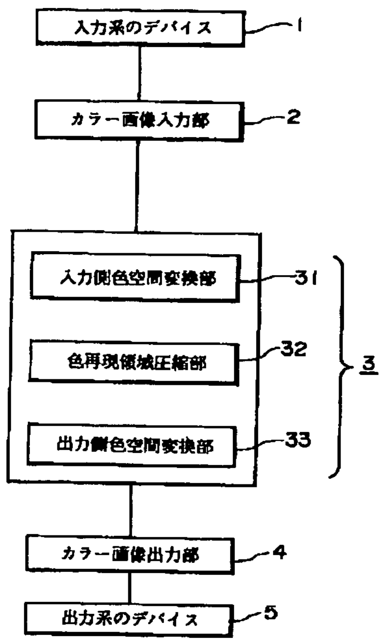
【図１２】従来の明度圧縮法による色域圧縮の手法を示す図である。

【図１３】従来の色差最小法による色域圧縮の手法を示す図である。

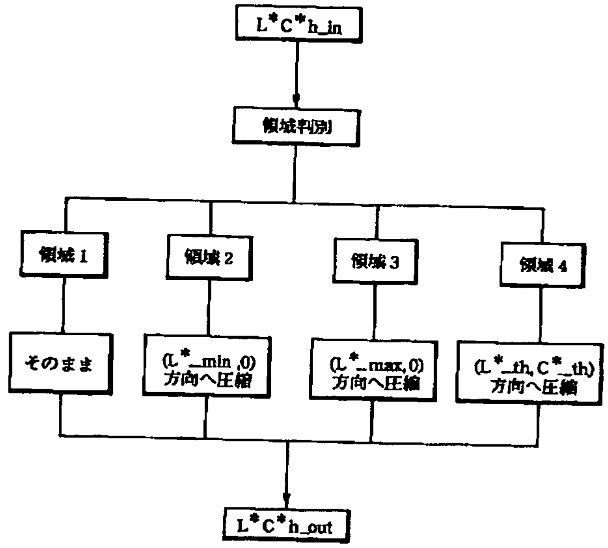
【符号の説明】

１　入力系デバイス
２　カラー画像入力部
３　画像処理部
４　カラー画像出力部
５　出力系デバイス
３１　入力側色空変換部
３２　色再現領域圧縮部
３３　出力側色空変換部

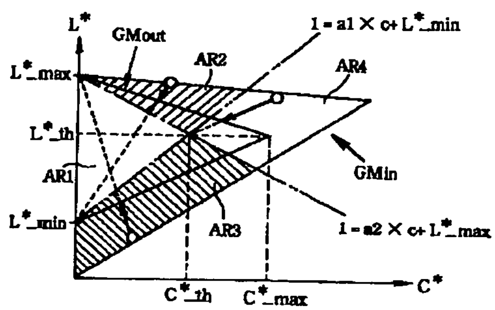
【図１】



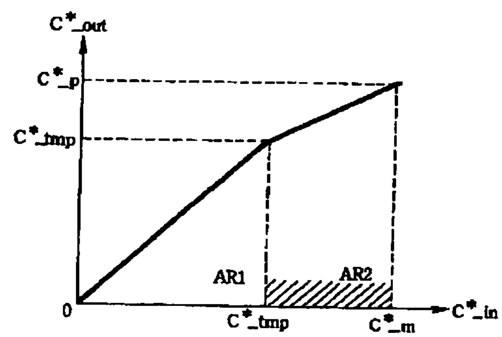
【図２】



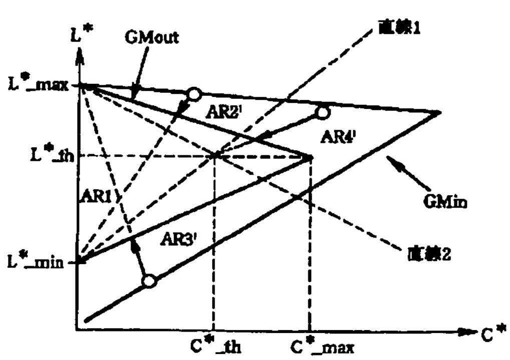
【図３】



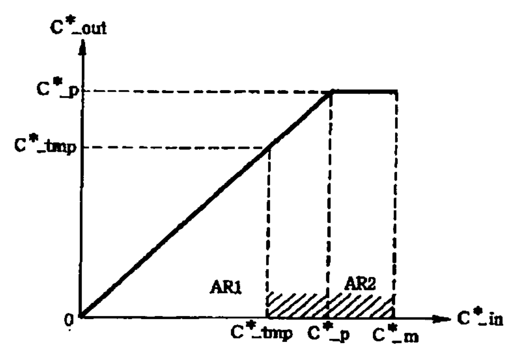
【図４】



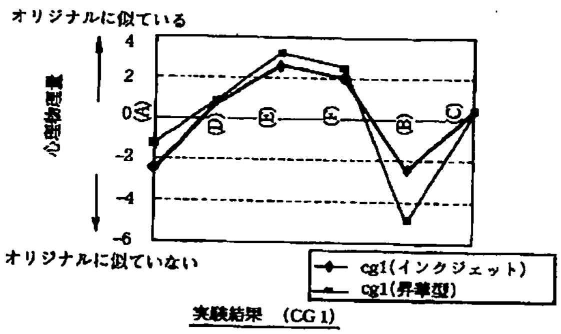
【図５】



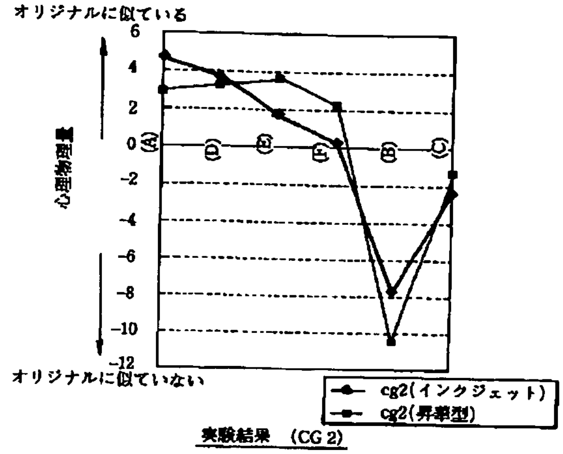
【図６】



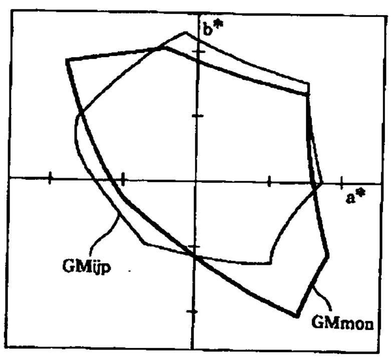
【図7】



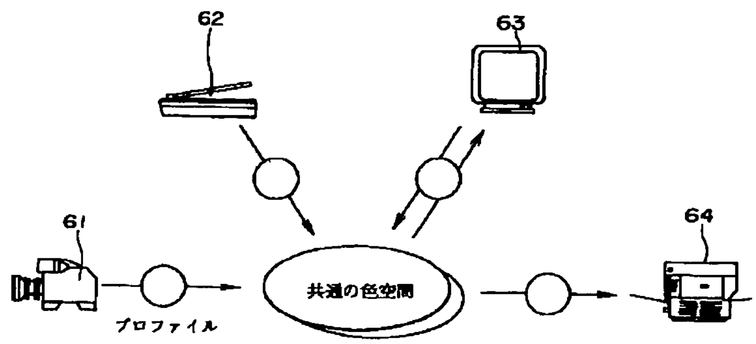
【図8】



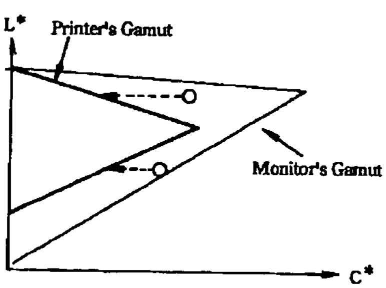
【図9】



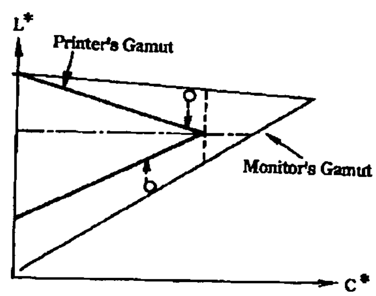
【図10】



【図11】



【図12】



【図13】